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Work Plan for a
Treatability Study in Support of the
Intrinsic Remediation (Natural Attenuation) Option at
The BX Shoppette (Site E11)



Eaker Air Force Base Blytheville, Arkansas

Prepared For

Air Force Center for Environmental Excellence Technology Transfer Division Brooks Air Force Base San Antonio, Texas

and

Air Force Base Conversion Agency/OL-J Eaker Air Force Base Blytheville, Arkansas

January 1996

AQM01-01-0358

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WORK PLAN FOR A TREATABILITY STUDY IN SUPPORT OF INTRINSIC REMEDIATION (NATURAL ATTENUATION) OPTION AT THE BX SHOPPETTE (SITE E11)

EAKER AIR FORCE BASE BLYTHEVILLE, ARKANSAS

January 1996

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
TECHNOLOGY TRANSFER DIVISION
BROOKS AIR FORCE BASE
SAN ANTONIO, TEXAS

and

AIR FORCE BASE CONVERSION AGENCY/OL-J EAKER AIR FORCE BASE BLYTHEVILLE, ARKANSAS

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SECTION 1

INTRODUCTION

This work plan, prepared by Parsons Engineering Science, Inc. (Parsons ES), presents the scope of work required for the collection of data necessary to conduct a treatability study (TS) for remediation of groundwater contaminated with petroleum hydrocarbons at the Base Exchange (BX) Shoppette underground storage tank site (Site E11) located at Eaker Air Force Base (AFB) (the Base), near the city of Blytheville, Arkansas. Several groundwater remedial options will be evaluated as a part of the TS report, including: active bioremediation (i.e., air sparging and bioventing); groundwater extraction, treatment, and disposal (i.e., pump and treat); and natural contaminant attenuation (intrinsic remediation) with long-term monitoring. Hydrogeologic and groundwater chemical data necessary to evaluate the various remedial options will be collected under this program; however, this work plan is oriented toward the collection of hydrogeologic data to be used as input into groundwater flow and solute transport models in support of intrinsic remediation for restoration of groundwater contaminated with benzene, toluene, ethylbenzene, and xylene (BTEX).

As used in this report, the term "intrinsic remediation" refers to a management strategy that relies on natural attenuation mechanisms to remediate contaminants dissolved in groundwater and to control receptor exposure risks associated with contaminants in the subsurface. "Natural attenuation" refers to the actual physical, chemical, and biological processes that facilitate intrinsic remediation. Mechanisms for natural attenuation of BTEX include biodegradation, advection, dispersion, dilution from recharge, sorption, and volatilization. Of these processes, biodegradation is the only mechanism working to

transform contaminants into innocuous byproducts. Intrinsic bioremediation occurs when indigenous microorganisms work to bring about a reduction in the total mass of contamination in the subsurface without the addition of nutrients. Patterns and rates of intrinsic remediation can vary markedly from site to site depending on governing physical and chemical processes.

As part of the TS, the contaminant fate and transport modeling effort has three primary objectives: 1) predict the future extent and concentration of dissolved contaminant plumes by modeling the effects of advection, dispersion, sorption, and biodegradation; 2) assess the possible exposure of potential downgradient receptors to contaminant concentrations that exceed levels intended to be protective of human health and the environment; and 3) provide technical support for selection of the intrinsic remediation option as the best remedial alternative at regulatory negotiations, as appropriate. The modeling efforts for the BX Shoppette at Eaker AFB will involve completion of several tasks, which are described in the following sections.

This work plan was developed following discussions among representatives from the Air Force Center for Environmental Excellence (AFCEE), Air Force Base Conversion Agency (AFBCA), and Parsons ES at a meeting held at the Base on November 16, 1995, the statement of work (SOW) for this project, and on a review of existing site characterization data. All field work will follow the health and safety procedures presented in the program *Health and Safety Plan for Bioplume II Modeling Initiative* (Engineering Science, Inc., 1993), and the site-specific addendum to the program Health and Safety Plan. This work plan was prepared for AFCEE and AFBCA.

1.1 SCOPE OF CURRENT WORK PLAN

The ultimate objective of the work described herein is to provide a TS for remediation of hydrocarbon groundwater contamination at the BX Shoppette. However, this project is part of a larger, broad-based initiative being conducted by AFCEE in conjunction with the US Environmental Protection Agency (USEPA) and Parsons ES to document the

biodegradation and resulting attenuation of fuel hydrocarbons and solvents dissolved in groundwater, and to model this degradation using numerical and analytical groundwater model codes. For this reason, the work described in this work plan is directed toward the collection of data in support of this initiative. Data sufficient to develop a 30-percent design of an alternate groundwater remediation system, should intrinsic remediation not prove to be a viable remedial option at this facility, also will be collected under this program. This work plan describes the site characterization activities to be performed by personnel from Parsons ES in support of the TS and the groundwater modeling effort. Field activities will be performed to determine the extent of mobile and residual light nonaqueous-phase liquid (LNAPL) at the site and to determine the extent of dissolved contamination. The data collected during the TS will be used along with data from previous investigations to complete the characterization of the site. These data will also be used in the groundwater flow and solute transport models to make predictions of the future concentrations and extent of contamination.

Site characterization activities in support of the TS will include: 1) determination of preferential contaminant migration and potential receptor exposure pathways; 2) soil sampling using cone penetrometer (CPT) direct-push technology; 3) groundwater monitoring point placement; 4) groundwater sampling; and 5) aquifer testing. The materials and methodologies to accomplish these activities are described herein. Previously reported site-specific data and data collected during the supplemental site characterization activities described in this work plan will be used as input for the groundwater flow and solute transport models. Where site-specific data are not available, conservative values for the types of aquifer materials present at the site will be obtained from widely accepted published literature and used for model input. Sensitivity analyses will be conducted for the parameters that are known to have the greatest influence on the model results, and where possible, the model will be calibrated using historical site data. Upon completion of the modeling, Parsons ES will provide technical assistance at regulatory negotiations to support the intrinsic remediation option if the results of the modeling indicate that this approach is warranted. If it is shown that intrinsic remediation

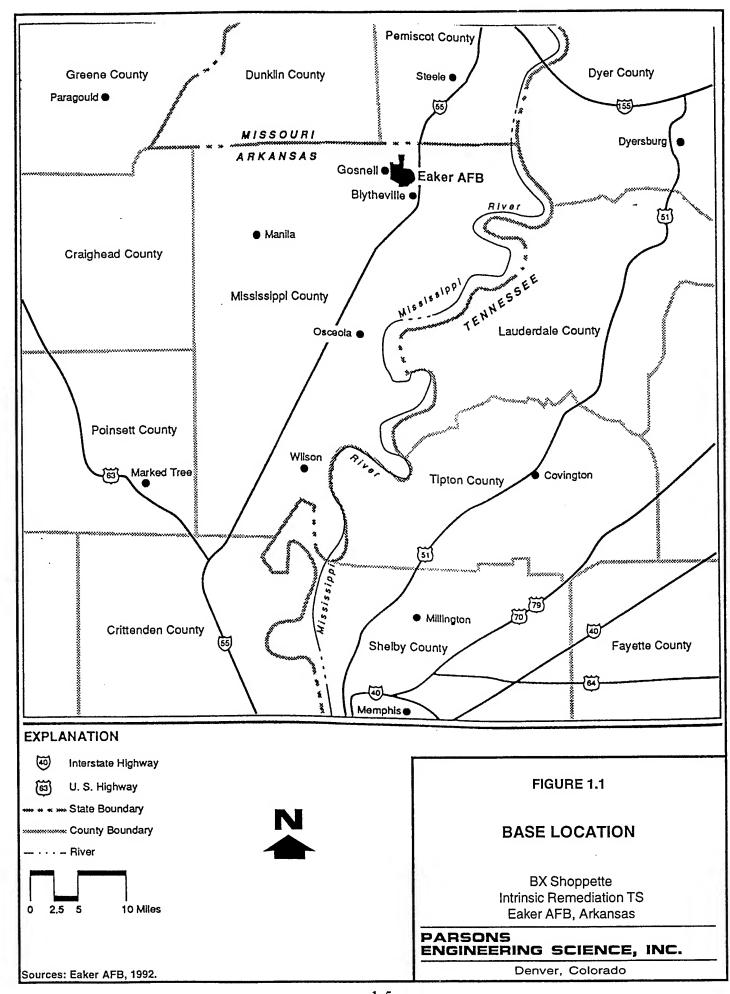
is not the most appropriate remedial option, Parsons ES will recommend the most appropriate groundwater remedial technology on the basis of available data.

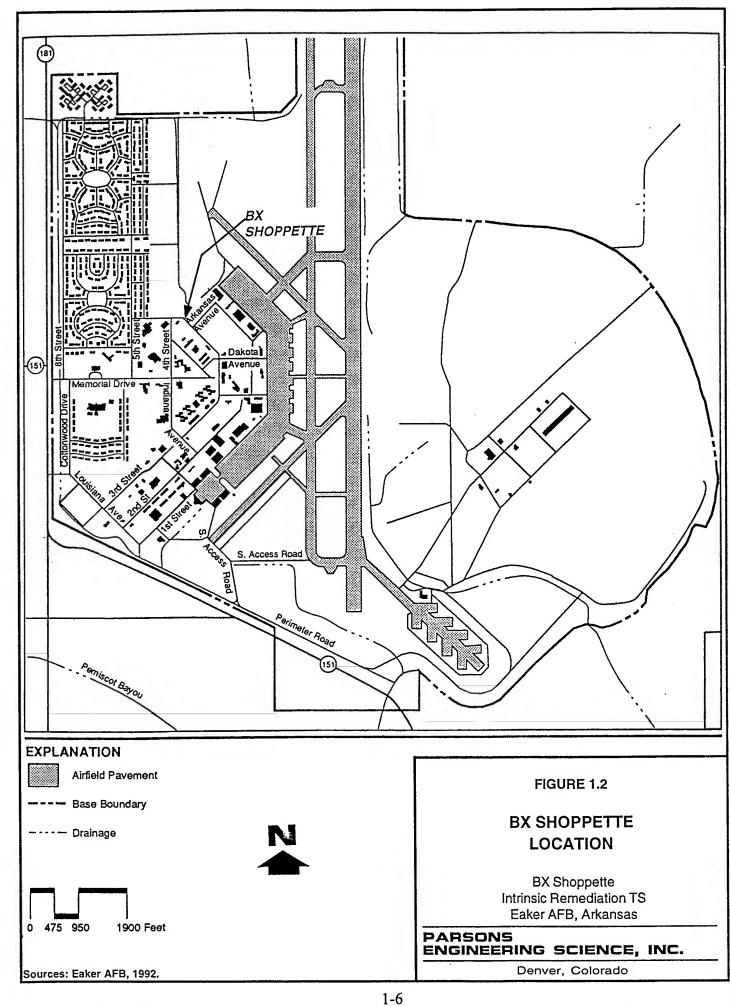
This work plan consists of six sections, including this introduction. Section 2 presents a review of available (previously reported) site-specific data, and conceptual models for the site. Section 3 describes the proposed sampling strategy and procedures to be used for the collection of additional site characterization data. Section 4 describes the remedial option evaluation procedure and TS report format. Section 5 describes the quality assurance/quality control (QA/QC) measures to be used during this project. Section 6 contains the references used in preparing this document. There are two appendices to this work plan. Appendix A contains a listing of containers, preservatives, packaging, and shipping requirements for soil and groundwater samples. Appendix B contains a summary of site data, including available well logs, and summaries of historical soil and groundwater analytical data from previous field investigations.

1.2 BACKGROUND

Eaker AFB is located in the northeastern corner of Arkansas, in Mississippi County, approximately 3 miles south of the Missouri state line and 11 miles east of the Tennessee state line. The Base occupies an area of approximately 3,300 acres 2 miles northwest of Blytheville, Arkansas and adjacent to the community of Gosnell (Figure 1.1). The Base is divided roughly in half by the main north/south runway (Figure 1.2). Aviation support, approximately 930 Base housing units, a hospital, and commercial facilities are located in the western portion of the Base. The eastern half of the Base is dedicated primarily to agricultural, recreational, and industrial activities. The predominant existing land use surrounding Eaker AFB is agricultural, with some residential parcels (Eaker AFB, 1992).

The Base was established in 1942 as the Blytheville Army Airfield and served as a training center until deactivation in 1945. From 1947 to 1955, the site was used for manufacturing, private housing, and as an airport. The Base was reactivated as Blytheville AFB in 1955 under the direction of the Tactical Air Command, and then

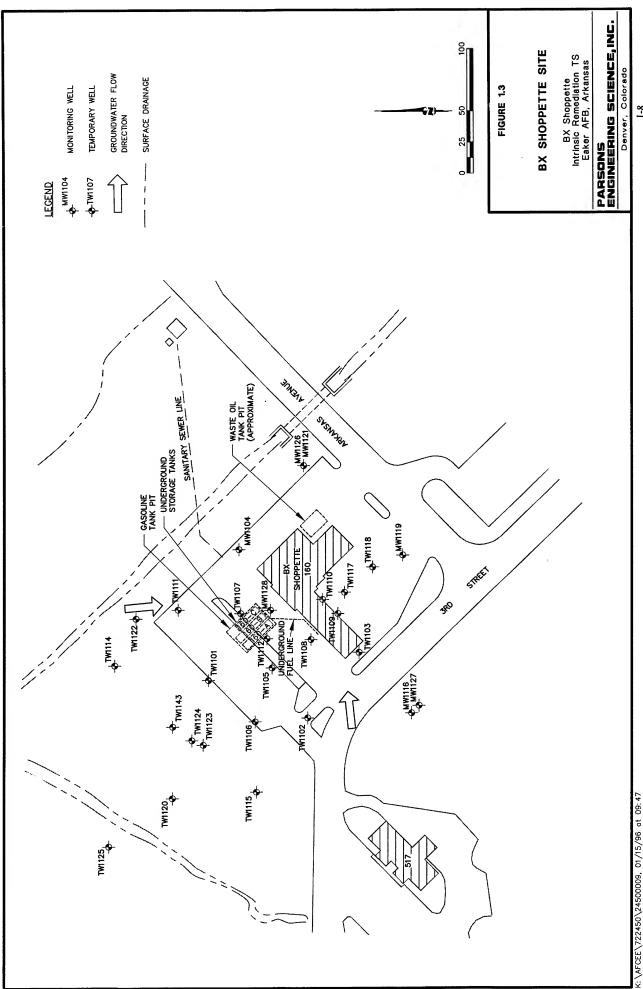




transferred to the Strategic Air Command (SAC) in 1958. The 97th Bombardment Wing assumed command of the Base until the disestablishment of SAC in 1992, when control was transferred to the Air Combat Command. In 1988, the Base was renamed Eaker AFB. Base operations in 1990 employed approximately 3,600 civilian and military personnel (Eaker AFB, 1992). In July 1991, the recommendation for base closure was approved and closure was scheduled for December, 1992.

The BX Shoppette site is located in the west-central portion of the base (Figure 1.2) and is bounded by open land to the north and west, and by base operations facilities to the east and south. Two 10,000-gallon USTs were installed at the site in 1969. The tanks (160-A and 160-B) contained regular unleaded gasoline and were steel-constructed, tarcoated, and corrosion protected by sacrificial anodes (cathodic protection). Two additional USTs (160-C and 160-D) were installed in 1971. Tank 160-C was steel-constructed, tar-coated, and cathodically protected. The tank capacity was 6,000 gallons. The tank originally contained regular leaded gasoline; however, the tank was converted to a premium unleaded gasoline tank in 1990. Tanks 160-A, -B, and -C are located within a gasoline tank pit, approximately 30 feet northwest of the BX Shoppette (Figure 1.3). Tank 160-D, a 1,000-gallon tank used to store waste oil, is located in the northeastern corner of the shoppette building (Figure 1.3). This tank is constructed of steel but is not cathodically protected (Halliburton NUS, 1994).

In 1974, a leak in the pipeline from the fuel USTs to the fuel dispensers was repaired. An unknown amount fuel was released prior to repair of the 1974 pipeline leak, and no hydrocarbon-contaminated soils were removed during the repair (Halliburton NUS, 1992). In December 1989, a tank tightness test was performed on the BX Shoppette USTs. Tank 160-A failed the tightness test and was subsequently deactivated in March 1990. In August 1990, a tank and line tightness test was performed on the remaining USTs and fuel dispensing system. This test indicated leaks in one of the 10,000-gallon USTs, the 6,000-gallon UST, and the waste oil tank. The tops of the tanks were exposed and isolated from their associated piping for retesting. All four tanks passed the retesting.



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In February and June 1991 a total of 28 soil borings were installed by Professional Services, Inc. (PSI) (Halliburton NUS, 1992). These borings confirmed the presence hydrocarbons in the soil around the tank pit and identified free product in groundwater. Halliburton NUS (1992, 1994, and 1995) continued site investigation under the Installation Restoration Program (IRP) and collected additional soil samples, installed monitoring wells, and sampled site groundwater. The horizontal limits of soil BTEX contamination have been established, however the vertical extent of soil BTEX has not been defined. BTEX compounds have been detected in soil samples from 22 feet below ground surface (bgs) between the fuel tank pit and the BX Shoppette. Mobile LNAPL was up to 4 feet thick in an area southwest of the gasoline tank pit, as measured in May 1992. Groundwater is contaminated and may be preferentially migrating laterally along thin layers of silt and sand between clay layers. In February 1992, Eaker AFB personnel bailed a total of 10.75 gallons of free product from monitoring well TW1105. Other than this action, no product recovery has taken place (Halliburton NUS, 1994).

SECTION 2

DATA REVIEW AND CONCEPTUAL MODEL DEVELOPMENT

Previously reported site-specific data were reviewed and used to develop a conceptual site model (CSM) for the groundwater flow and contaminant transport conditions at the BX Shoppette. The CSM guides the selection of sampling locations and analytical data requirements needed to support the modeling efforts and to evaluate potential remediation technologies (including intrinsic remediation). Section 2.1 presents a synopsis of available site characterization data. Section 2.2 presents the preliminary conceptual groundwater flow and contaminant transport model that was developed based on these data.

2.1 DATA REVIEW

The following sections are based upon review of the following sources:

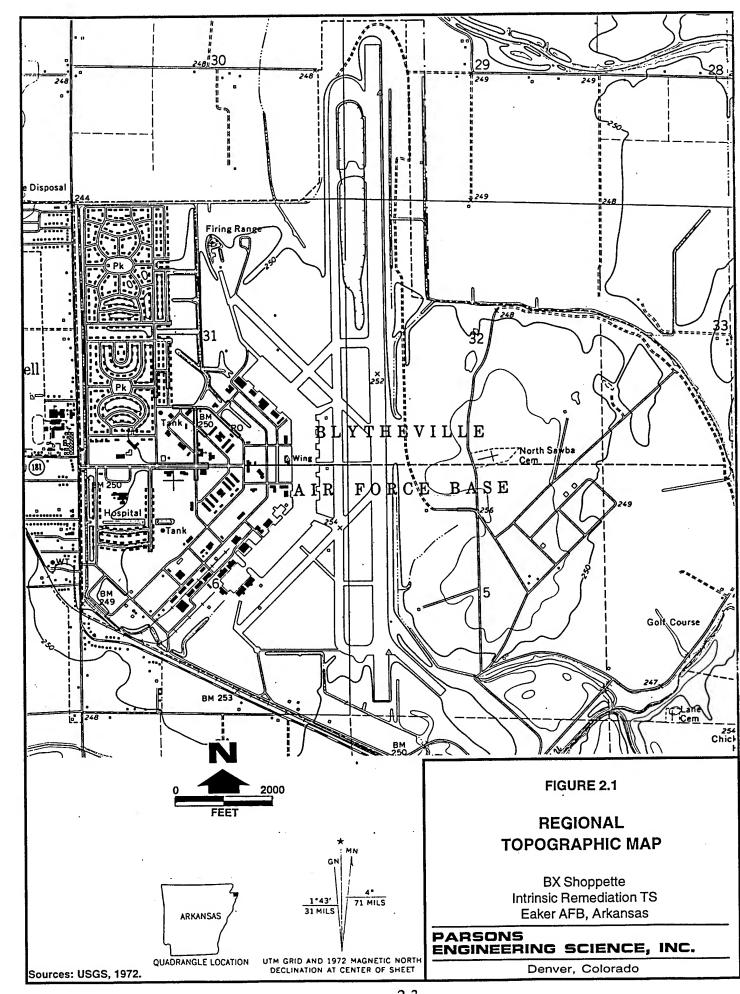
- Final Environmental Impact Statement Disposal and Reuse of Eaker Air Force Base, Arkansas (FEIS) (Eaker AFB, 1992);
- IRP Draft Site Assessment Report for the BX Shoppette Underground Storage
 Tank Site (Halliburton NUS, 1992),
- Unpublished site data (Halliburton NUS, 1994 and 1995); and

 Site Characterization and Analysis System (SCAPS) Report [US Army Corps of Engineers (USACE, 1995)].

2.1.1 Topography, Surface Hydrology, and Climate

Eaker AFB is located within the Mississippi Embayment of the Atlantic and Gulf Plains physiographic province (Eaker AFB, 1992), and lies within the eastern lowland portion of the Central Mississippi River Valley. The topography in the region is generally level except in areas adjacent to the Mississippi River. Ground surface elevations on the Base range from 245 feet above mean sea level (msl) at the southeastern end of the Base (in the vicinity of Pemiscot Bayou) to 265 feet msl at the northwestern end of the Base, near the firing range (Figure 2.1). At the BX Shoppette, the topography is flat and the ground surface elevation is approximately 250 feet msl.

Eaker AFB is located within the St. Francis River watershed of the Lower Mississippi River Basin. Surface water drainage is characteristic of the Mississippi River floodplain, and drainage ditches and bayous have been dredged in the flat terrain to accommodate surface water runoff. The majority of the Base lies above the level of the 100-year floodplain, and the potential for flooding is minimal. A combination of open drainage ditches and storm drains is used to capture and direct runoff from the Base (Eaker AFB, 1992). Stormwater runoff in the eastern portion of the Base drains to Pemiscot Bayou, while surface water flow on the western half of the Base drains to Ditch 25. Both of these drainage channels flow southwest to the Little River, which discharges into the St. Francis River. The St. Francis River discharges into the Mississippi River approximately 150 miles south of Eaker AFB. Surface water flow at the BX Shoppette discharges into the adjacent surface drainages which flow into Ditch Number 25, located approximately 4,000 feet north of the site.



The Eaker AFB climate is subtropical, with mild winters and hot, humid summers. July is the warmest month with an average maximum daily temperature of 90 degrees Fahrenheit (°F). The coolest month is January with an average minimum daily temperature of 28°F. The average annual precipitation is 48.3 inches, which is evenly distributed throughout the year. The average annual relative humidity is 69 percent. Flooding occurs during periods of prolonged heavy rainfall, and during the summer months climatic conditions make tornado formation possible (Eaker AFB, 1992).

2.1.2 Overview of Geology and Hydrogeology

2.1.2.1 Regional Geology and Hydrogeology

The shallow subsurface geology of northeastern Arkansas consists of Quaternary alluvium, which is thickest near the Mississippi River and thins in a westerly direction. The alluvium is composed of interbedded clays, silts, sand, and minor gravel and has an average thickness of 125 feet (Eaker AFB, 1992). The shallow, unconsolidated, Quaternary sediments on Eaker AFT are interpreted to be flood plain and channel deposits associated with the past and present positions of the Mississippi River (Halliburton NUS, 1992). The overlying soils are weathering products of the alluvial deposits and are generally nontransmissive, fine-grained, clayey soils. These soils impede infiltration and allow for rapid runoff of surface water.

Sediments in the vicinity of the Base consist of over 2,000 feet of Tertiary and Cretaceous unconsolidated deposits overlying Lower Paleozoic carbonate bedrock (Eaker AFB, 1992). The Tertiary Wilcox Formation is present approximately 900 feet below the Base. The lower part of this formation is composed of sands that produce potable water used by Eaker AFB, the city of Blytheville, and the city of Gosnell (Eaker AFB, 1992).

The aquifer is under confined conditions, and the water quality is excellent. Water treatment is required only to remove slightly elevated iron concentrations. The lower Wilcox Formation aquifer is protected from contamination by approximately 800 feet of interbedded unconsolidated sands and clays that form the Claiborne Group.

Shallow groundwater in the vicinity of the Base is present between 7 and 12 feet bgs and in the Quaternary alluvial sands. Irrigation wells and rural residences generally obtain water from these Quaternary sands (Eaker AFB, 1992). The upper part of the Quaternary deposits consists of sandy clay and clay, while the remainder of the deposits are sand and gravel. The sands and gravels comprise the major water-bearing units in the Quaternary deposits. Water from the alluvial aquifer is characterized as moderately hard to very hard hardness (as calcium bicarbonate). The water table is highest in the area northeast of the Base, indicating an area of surface recharge to the Quaternary sands and gravels (Eaker, 1992). Flood control for the Mississippi River and local flooding are responsible for some groundwater elevation fluctuation. Groundwater in the vicinity of Eaker AFB flows southwest to south.

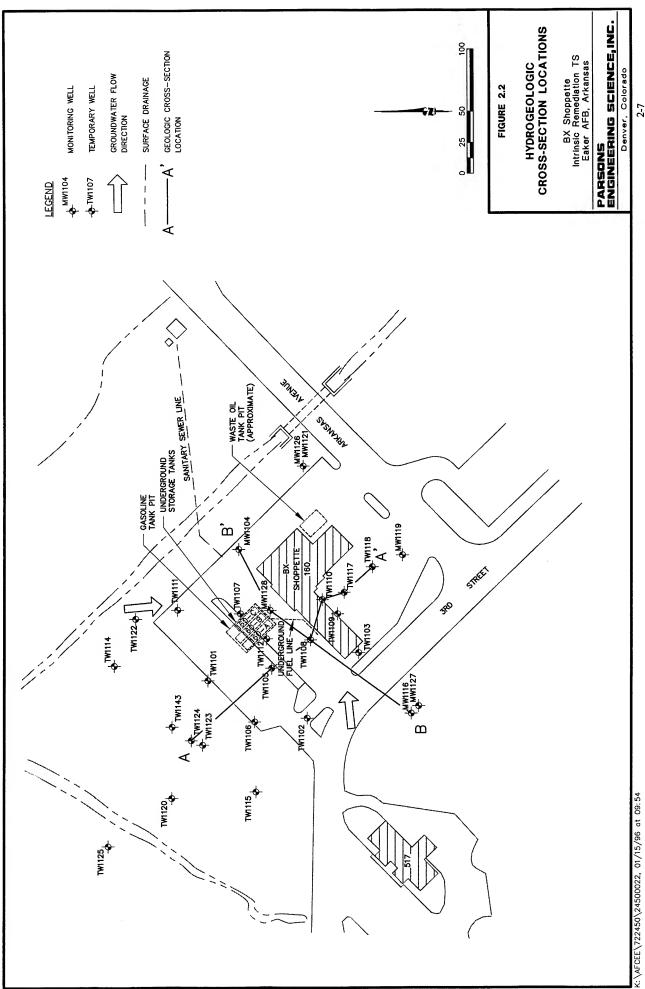
2.1.2.2 BX Shoppette Geology and Hydrology

Most of the ground surface at the BX Shoppette is covered by about 6 inches of asphalt pavement overlying approximately 2 to 4 feet of sandy fill material. On the basis of information collected during the previous investigations, the shallow alluvial sediments at the site consist primarily of interbedded clays (with or without silt), sands, and sandy clays. Below the fill are several interbedded clayey, sandy, and silty layers extending to approximately 10 to 15 feet bgs. This series of units varies in texture both laterally and vertically across the site. Underlying the top 12 to 19 feet of soil is a stiff, gray and brown clay. The base of the clay layer is undefined, but this layer is suspected

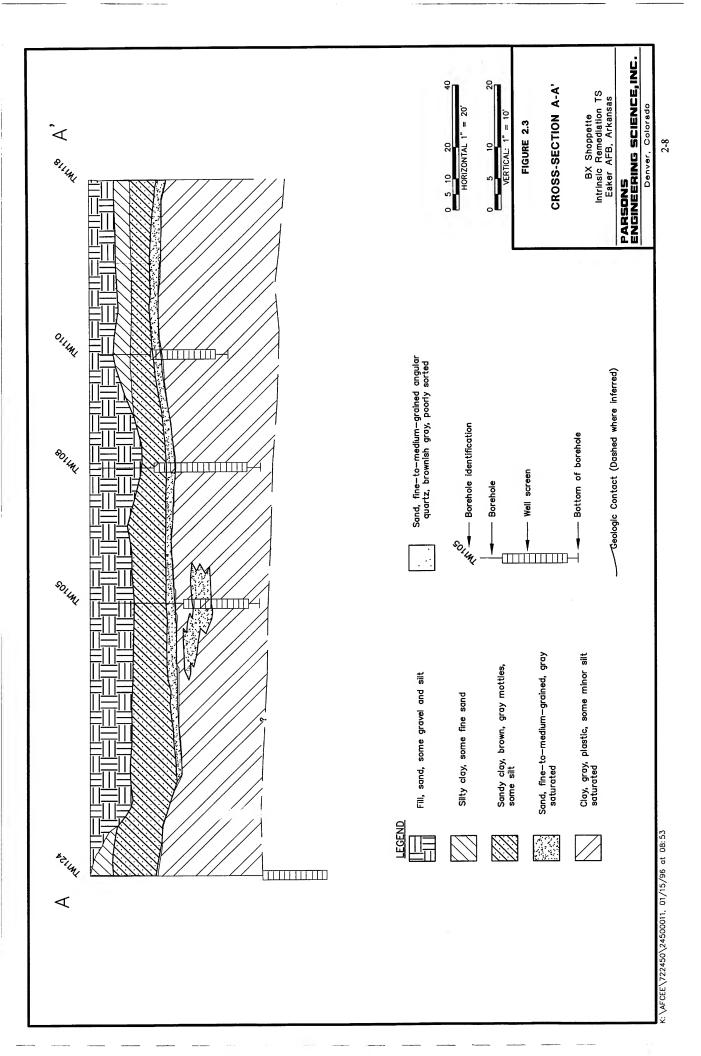
to be a minimum of 10 feet thick. A medium- to coarse-grained sand unit underlies the clay where the sand is present. The sand has not been observed in all deep boreholes and is not believed to be laterally continuous across the site. Figure 2.2 shows the location of stratigraphic cross-sections A-A' and B-B'. Figure 2.3 presents cross-section A-A', which is oriented in a northwest-southeast direction along the axis of groundwater flow. Figure 2.4 presents cross-section B-B', oriented southwest-northeast, approximately perpendicular to the direction of groundwater flow.

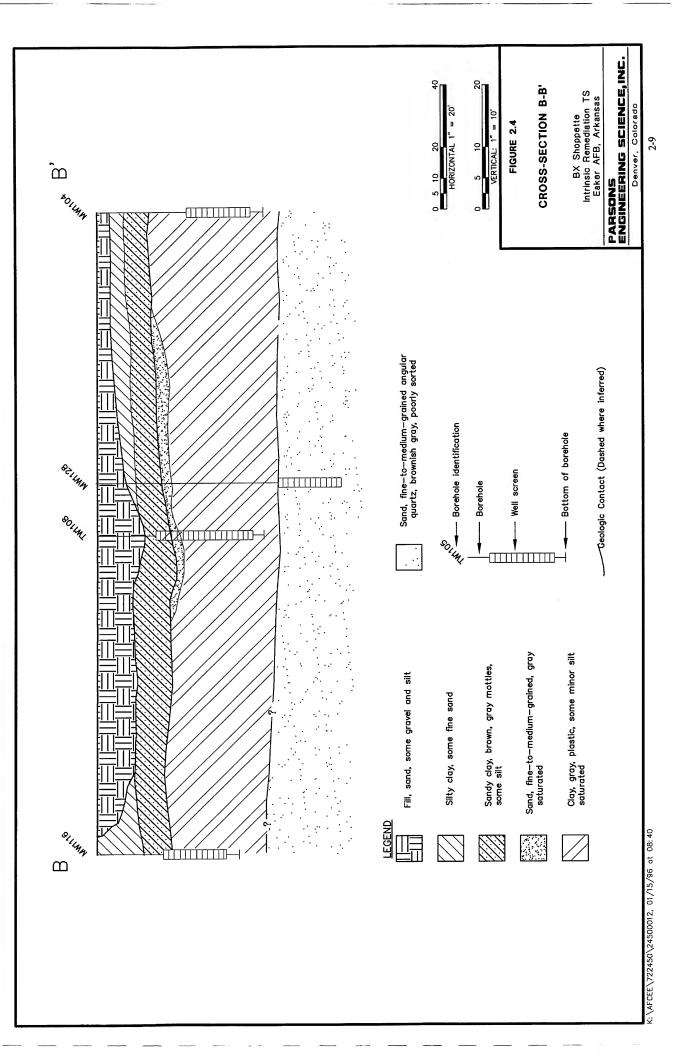
The cross-sections were constructed using geologic boring logs from the Halliburton NUS (1992) site investigation and CPT/laser induced fluorescence (LIF) verification data results collected by the US Army Corps of Engineers (USACE, 1995). The CPT soil data were interpreted using a soil classification graph and a fluorescence graph. The soil graph is constructed by referencing the strain gauge readings, calibration curves, and an empirical relationship. The fluorescence graph presents the relative measurement of the returned fluorescence from the LIF window on the probe. This is a relative measurement of the fuel hydrocarbon contamination. By comparing the CPT soil graph with existing adjacent soil borehole logs, the data were correlated to produce a more complete cross-section and to better define locations of suspected mobile LNAPL. Appendix B presents available geologic boring logs and CPT/LIF output logs

Borehole logs from downgradient monitoring well MW1126 at the eastern corner of the BX Shoppette near Arkansas Avenue (Figure 2.2) show that soils from the surface to 3 feet bgs are a silt and fine-grained sand. From 3 feet bgs to approximately 14 feet bgs is an orange-brown, silty clay, with the silt content decreasing with depth. Below 14 feet bgs, a dark-gray to brown clay with organic fragments and worm burrows extends to 25 feet bgs. The silt content of the clay soil increases with depth, and a fine-grained sandy



2-7





clay is present to a depth of approximately 29 feet bgs. From 29 feet bgs to a total drilled depth of 41 feet bgs a medium-grained, poorly sorted quartz sand is present.

There are currently 21 groundwater monitoring wells at the BX Shoppette. Seven former temporary monitoring wells have been abandoned at the site. All of the wells are screened in the shallow alluvial deposits. These wells were installed during several site investigations as part of the IRP. Groundwater at the site occurs in the sandy units of the Quaternary alluvium and may be perched above the finer-grained clay sediments. Available monitoring well construction details are presented in Table 2.1. Figure 2.5 shows the groundwater surface for the BX Shoppette in March 1992.

Groundwater flow in the immediate vicinity of the site appears to converge on the site from two different directions. West of the BX Shoppette the groundwater flow is to the northeast; however, the confluence of two drainage channels north of the station appears to create a recharge zone, resulting in a southerly groundwater flow from the confluence toward the site. As a result, groundwater flow directly beneath the BX Shoppette is deflected to the east by the convergent flows. The hydraulic gradient across the site ranges from 0.016 foot per foot (ft/ft) south of the fuel tank pit to 0.0017 ft/ft in the immediate tank pit and dispenser area (Halliburton NUS, 1992). The groundwater surface shown on Figure 2.5 correlates with the shape and orientation of the groundwater BTEX plume, implying that the groundwater flow direction at the site is relatively consistent. The converging groundwater flow combined with the small gradient beneath the site, gives groundwater a relatively longer residence time below the site.

In 1988, Halliburton NUS (1992) performed slug tests on shallow aquifer monitoring wells located approximately 2,500 feet northeast of the BX Shoppette. Using the methods of Bouwer and Rice (1976), hydraulic conductivity values at monitoring wells

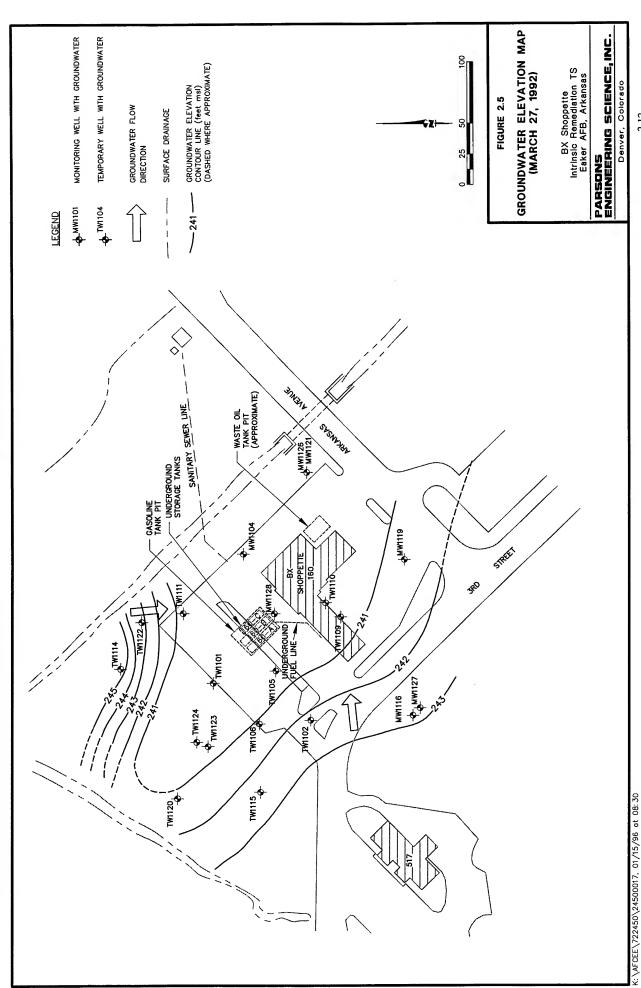
TABLE 2.1 SUMMARY OF WELL COMPLETION DATA BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

			Completion	Canada	Cassand	Ton of
	T	Total Depth	Completion	Screened Interval	Ground Elevation	Top of
*** ** **	Installation		Depth			Casing
Well ID	Date	(ft bgs)	(ft bgs)	(ft bgs)	(ft msl)	(ft msl)
TW1101	12/11/91	30	27.2	15.2-25.2	NA ^{a/}	NA
TW1102	12/11/91	30	24.7	12.4-22.6	NA	249.52
TW1103 ^{b/}	12/11/91	30	27.1	15.1-25.1	NA	249.99
MW1104	12/11/91	30	26.1	14.1-24.1	NA	251.48
TW1105	12/13/91	26	25.2	13.4-23.4	NA	251.14
TW1106	12/13/91	29	25.7	13.5-23.7	NA	250.98
TW1107	12/13/91	30	27.2	15.1-25.2	NA	251.31
TW1108	12/14/91	29	25.2	8.2-23.2	NA	250.75
TW1109	12/14/91	25	20.2	8.2-18.2	NA	250.89
MW1110	12/14/91	25	20.3	8.2-18.2	NA	251.23
MW1111	12/15/91	22	20.1	8.1-18.1	NA	251.32
TW1112	12/15/91	25	25.1	8.1-25.1	NA	250.86
TW1113	12/15/91	27	25.3	8.4-23.3	NA	252.01
MW1114	12/16/91	24	18.4	6.2-16.4	NA	251.64
MW1115	12/16/91	22	18.3	6.2-16.3	NA	250.37
MW1116	12/16/91	22	20	7.9-18.0	NA	250.62
TW1117	12/17/91	12	NA	NA	NA	250.83
TW1118	12/17/91	12	NA	NA	NA	250.42
MW1119	12/17/91	22	17	5.0-15.0	NA	249.75
MW1120	1/7/92	30	29.2	17.2-27.2	NA	251.73
MW1121	4/8/95	17	16.2	4.2-14.2	250.97	253.16
MW1122	4/7/95	18	17.3	5.1-15.1	250.68	253.02
MW1123	8/11/95	20	19	7.0-17.0	251.13	253.56
MW1124	8/12/95	38	38	26.0-36.0	251.93	253.58
MW1125	10/31/95	38	38	26.0-36.0	250.58	253.48
MW1126	11/1/95	41	41	29.0-39.0	250.91	253.70
MW1127	11/3/95	37	36.5	24.5-34.5	250.76	250.56
MW1128	11/5/95	40	40	28.0-38.0	NA	251.34

^a/ NA = Data not availible.

Sources: Halliburton NUS, 1992 and 1995.

b/ Temporary wells TW1103, TW1107, TW1108, TW1112, TW1113, TW1117, and TW1118 have been removed.



MW502 and MW504 were calculated to be 2.1 x 10⁻⁴ centimeters per second (cm/sec) and 5.4 x 10⁻⁴ cm/sec, respectively. Using the average of these two measurements, Halliburton NUS (1992) estimated the hydraulic conductivity to be 1.06 feet per day (ft/day) (3.7 x 10⁻⁴ cm/sec) beneath the site. Using a gradient of 0.0017 ft/ft and an estimated porosity of 0.25, the groundwater velocity at the BX Shoppette is approximately 0.007 ft/day. Halliburton NUS (1992) assumed an aquifer thickness of 10 feet and calculated an estimated aquifer transmissivity of 79 gallons per day per foot (gal/day/ft) in the shallow alluvial aquifer below the BX Shoppette.

2.1.3 Summary of Analytical Data for BX Shoppette

2.1.3.1 Soil Sampling and Analytical Results

Historical soil sampling data are available for sampling events that took place in 1991 and 1995. In 1991, 56 soil samples were collected by Halliburton NUS (1994) from boreholes B-1 through B-27, and 12 soil samples were collected from boreholes for wells TW1103, TW1108, TW1109, and TW1110 (Figure 2.6). Four years later, Halliburton NUS (1995) collected 11 additional soil samples during the installation of monitoring wells MW1121 through MW1123 and soil boreholes SB1129 through SB1135. All the soil samples collected during these sampling events were analyzed for BTEX and total petroleum hydrocarbons (TPH). Some soil samples were analyzed for additional contaminants [i.e., metals and semivolatile organic compounds (SVOCs)]; however, results reported for these additional analytes are not of primary importance for completion of this TS and are not summarized in this work plan. Table 2.2 summarizes BTEX and TPH results for all soil samples collected during these sampling efforts. Locations of soil samples collected during the 1991 investigation are shown on Figure 2.6.

TABLE 2.2
SUMMARY OF SOIL ANALYTICAL DATA
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

						Total	Total	
		Depth	Benzene	Toluene	Ethylbenzne	Xylenes	BTEX	TPH
Borehole ID	Date	(ft bgs)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B-1	2/91	5-10 ^{a/}	6.2	47	14	80	147.2	322
		15	2.4	8.2	4.5	17	32.1	176
B-2	2/91	5-10	2.3	24	7.7	40	74	248
		15	3.1	8.6	0.3	2.1	14.1	478
B-3	2/91	5-10	14	250	62	300	626	338
		15	3.6	16	1.8	9.8	31.2	176
B-4	2/91	5-10	. ND _M	22	3.7	14	39.7	484
		15	ND	ND	ND	ND	ND	477
B-5	2/91	5-10	15	130	22	90	257	559
		15	2.4	15	3.9	16	37.3	351
B-6	2/91	5-10	1.5	18	2.5	14	36	218
		15	1.6	6.2	1	4.6	13.4	147
B-7	2/91	5-10	3.8	44	7.3	44	99.1	212
		15	1.1	0.9	0.2	0.1	2.3	247
B-8	2/91	5-10	5	27	7	39	78	157
		15	ND	ND	ND	ND	ND	163
B-9	2/91	5-10	7.6	43	16	88	154.6	136
		15	1.6	1.4	0.2	0.5	3.7	179
B-10	2/91	5-10	11	72	20	110	213	152
		15	ND	ND	ND	ND	ND	203
B-11	2/91	5-10	3.2	15	2.8	14	35	234
		15	1.9	5.2	0.6	2.2	9.9	240
B-12	2/91	5-10	6.3	35	8.2	44	93.5	207
		15	1.6	5.2	0.5	2.4	9.7	210
B-13	6/91	5-10	5.3	24	6.8	33	69.1	<30
		15	0.7	1.1	ND	0.4	2.2	<30
		20	0.8	1.2	0.2	0.8	3	<30
B-15	6/91	5-10	5.1	4.2	9.4	73	91.7	46
		15	7.9	30	6.1	27	71	<30
		20	3.7	16	4.5	24	48.2	35
B-16	6/91	5-10	9	37	11	46	103	<30
		15	ND	ND	ND	ND	ND	<30
		20	ND	ND	ND	0.5	0.5	<30
B-17	6/91	5-10	2.3	13	4.3	26	45.6	<30
B-18	6/91	5-10	7.2	20	3.7	22	52.9	<30
		15	6.2	19	5.2	24	54.4	<30
B-19	6/91	5-10	0.5	3	5.4	19	27.9	<30
		15	0.6	1.8	ND	0.7	3.1	<30
		20	0.7	1.9	0.3	0.8	3.7	<30

TABLE 2.2 (Concluded) SUMMARY OF SOIL ANALYTICAL DATA

BX SHOPPETTE

INTRINSIC REMEDIATION TS

EAKER AFB, ARKANSAS

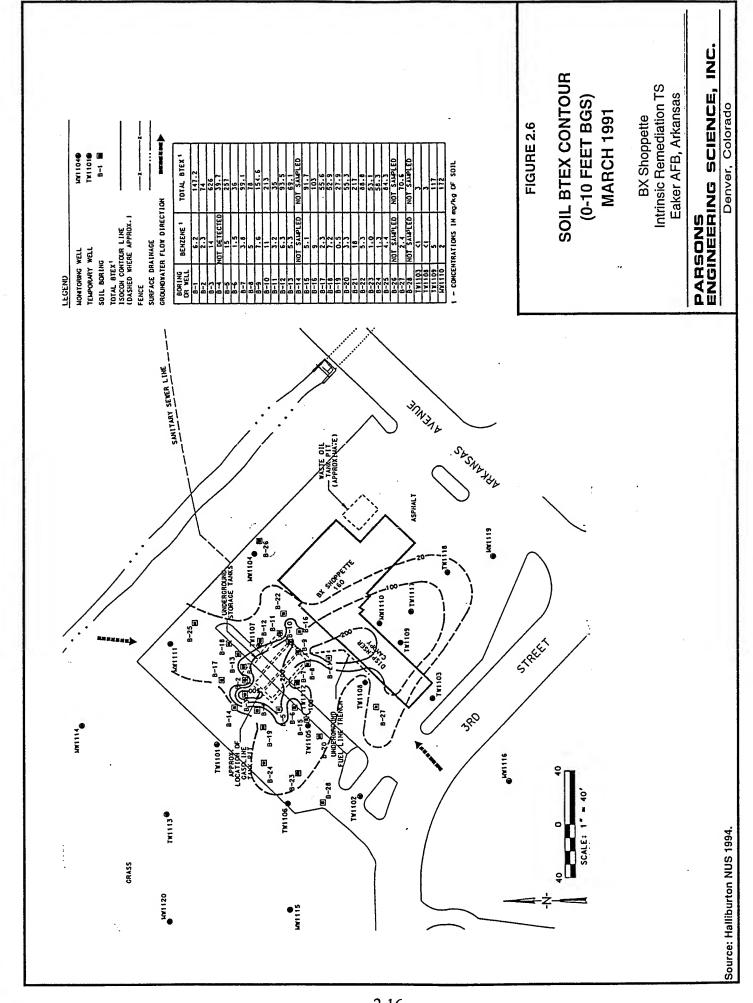
						Total	Total	
		Depth	Benzene	Toluene	Ethylbenzne	Xylenes	BTEX	TPH
Borehole ID	Date	(ft bgs)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B-20	6/91	5-10	3.3	26	ND	26	55.3	<30
		15	37	280	68	400	785	<30
		20	14	130	31	160	335	<30
B-21	6/91	5-10	18	84	15	100	217	30
		15	13	54	18	83	168	64
		20	8.4	22	4.7	27	62.1	<30
B-22	6/91	5-10	5.3	32	7.5	44	88.8	<30
		15	. 15	65	10	51	141	<30
B-23	6/91	5-10	1	17	7.1	28	53.1	<30
		15	0.6	2	1.9	7.8	12.3	<30
B-24	6/91	5-10	1.3	17	11	29	58.3	<30
		15	0.2	2.3	1.6	7.1	11.2	<30
		20	0.2	0.6	0.2	0.9	1.9	<30
B-25	6/91	5-10	4.4	28	7.9	44	84.3	<30
		15	0.2	0.8	0.1	0.8	1.9	<30
B-27	6/91	5-10	2.4	23	9.2	36	70.6	<30
		15	1.1	10	1.6	15	27.7	<30
TW1103	12/11/95	3	< 1	< 1	< 1	3	3	<20
		10	< 1	< 1	< 1	< 1	< 1	<20
		22	ND	< 1	< 1	< 1	< 1	<20
TW1108	12/14/95	5	< 1	< 1	< 1	3	3	<20
		17	< 1	< 1	1	4	5	<20
		21	< 1	< 1	< 1	< 1	< 1	<20
TW1109	12/14/95	6	5	17	17	78	123	172
		10	< 1	< 1	< 1	< 1	< 1	<20
		18	< 1	< 1	< 1	< 1	< 1	<20
TW1110	12/14/95	6-7	2	58	19	93	172	23
		8.5	1	19	< 1	51	71	<20
		16.5	< 1	3	< 1	3	6	<20
MW1121A	4/8/95	NA°	ND	ND	ND	ND	ND	ND
MW1122A	4/7/95	NA	< 1	< 1	ND	ND	< 1	ND
MW1123A	8/11/95	NA	ND	ND	ND	ND	ND	ND
SB1129A	4/6/95	NA	ND	ND	ND	ND	ND	ND
SB1130A	4/6/95	NA	ND	ND	ND	ND	ND	ND
SB1131A	4/7/95	NA	< 1	< 1	ND	ND	< 1	ND
SB1132A	4/9/95	NA	ND	ND	ND	ND	ND	ND
SB1133A	4/7/95	NA	ND	ND	ND	ND	ND	ND
SB1134A	4/8/95	NA	ND	ND	ND	ND	ND	ND
SB1135A	4/7/95	NA	0.9	2.7	1.1	5.4	10.1	38
SB1135B	4/7/95	NA	6.1	27	15	74	122.1	570

a' 5-10 foot samples were composited at 5 and 10 feet.

Sources: Halliburton NUS, 1992 and 1995.

b/ ND = not detected.

c/ NA = data not available.



During the 1991 investigation (Halliburton NUS, 1992), saturated and unsaturated zone soil samples were collected at depths ranging from 5 to 22 feet bgs. Soil BTEX contamination was identified in saturated samples collected below the water table at 20 feet below bgs. However, the saturated samples collected below about 10 feet bgs do not correlate with surface contamination sources and are believed to result from groundwater smear of mobile LNAPL. Appendix B presents figures from Halliburton NUS (1992) that contour the soil contamination below 10 feet bgs.

Significant concentrations of BTEX and TPH in unsaturated soils appear to be limited to soils in the vicinity of the gasoline tank pit and the underground fuel line trench. Figure 2.6 is an isocontour map showing BTEX contamination in soils to a maximum depth of 10 feet bgs. The unsaturated soil BTEX contamination appears to be confined within the site boundaries. The maximum total BTEX contamination measured in unsaturated soils [626 milligrams per kilogram (mg/kg)] was detected in soil borehole B-3, adjacent to the gasoline tank pit. Unsaturated soil contamination in the region of the UST pit is concentrated mostly to the north and west of, and below, the pit. The highest unsaturated total BTEX concentration not related to the tank pit contamination was located at borehole B-21 adjacent to the fuel line trench, that lies between the tank pit and The remainder of the soil sampling indicated lower BTEX the fuel dispensers. concentrations throughout the rest of the BX Shoppette site (Figure 2.6). The fluctuation of the groundwater surface, LNAPL dispersion, and isolated small fuel spills most likely are responsible for the lower outlying soil BTEX concentrations away from the two primary source areas (i.e., the gasoline UST pit and the fuel line).

2.1.3.2 Groundwater Sampling and Analytical Results

A total of 28 monitoring wells have been installed at the BX Shoppette. All of the wells have been installed by Halliburton NUS (1992 and 1995) during several phases of investigation. Seven temporary wells (TW1103, TW1107, TW1108, TW1112, TW1113, TW1117, and TW1118) were removed by Halliburton NUS (1992) after sampling and analysis. Available well construction details are presented in Table 2.1. All of the monitoring wells at the site are screened within the shallow unconsolidated sediments. Groundwater quality data were collected from the BX Shoppette wells in 1992 and 1995 (Halliburton NUS, 1992 and 1995) as part of site assessment activities. BTEX and TPH results for both groundwater sampling events are presented in Table 2.3.

Measurable mobile LNAPL (free product) has been observed in monitoring well TW1105. Immediately after installation, well TW1105 contained 0.3 foot of LNAPL. In January 1992, 5.35 feet of product was measured at monitoring well TW1105, and in February 1992, 10.75 gallons of product was bailed from the well by Eaker AFB personnel (Halliburton NUS, 1992). In May 1992, the LNAPL was measured at approximately 4 feet. Analysis of the LNAPL indicated the product is leaded gasoline. The storage and sale of leaded gasoline at the BX Shoppette ceased in March 1990; therefore, the release that resulted in the accumulation of LNAPL in this area likely occurred before 1990. It is possible that the 1974 leak in the fuel transfer line was the source of the mobile LNAPL in this area (Halliburton NUS, 1992). The lateral extent of the mobile LNAPL plume has not been determined, but the plume is believed to be limited because it has only been observed in monitoring well TW1105. However, the observed BTEX concentration of 36,800 micrograms per liter (μg/L) in a 1995 groundwater sample from monitoring well TW1111, about 100 feet north of TW1105, is

TABLE 2.3
SUMMARY OF GROUNDWATER ANALYTICAL DATA
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

					Total	Total	
	Sample	Benzene	Ethylbenzene	Toluene	Xylene	BTEX	TPH
Well ID	Date	(μg/L)	(μg/L)	(μg/L)	, (μg/L)	(µg/L)	(mg/L)
TW1101	6/1/95	610	310	440	880	2240	9
TW1102	6/1/95	$ND^{a\prime}$	ND	ND	ND	ND	ND
MW1104	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/2/95	130	210	170	560	1070	16
TW1105	NS ^{b/}	NS	NS	NS	NS	NS	NS
TW1106	6/2/95	ND	ND	ND	ND	ND	ND
TW1109	6/5/95	2200	170	160	1100	3630	15.5
MW1110	1/13/92	4800	2000	45000 J ^{c/}	7600	59700 J	2
	6/2/95	10000	1000	280	3200	14480	52.5
MW1111	1/13/92	5300 J	1500 J	< 2	7120 J	13920 J	2.7
	6/2/95	5000	2800	14000	15000	36800	21.2
	8/15/95	4100	2000	11000	14000	31100	67
MW1114	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1115	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1116	1/12/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1119	1/13/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/5/95	ND	ND	ND	ND	ND	ND
MW1120	1/12/92	< 2	< 2	< 2	< 2	< 8	< 0.2
	6/8/95	ND	ND	ND	ND	ND	ND
MW1121	6/8/95	ND	ND	ND	ND	ND	ND
MW1122	6/8/95	ND	ND	ND	ND	ND	ND
MW1123	8/24/95	ND	ND	ND	ND	ND	ND
MW1124	8/25/95	62	5.4	4.5	10	81.9	ND

Sources: Halliburton NUS, 1992 and 1995.

^a/ ND = Not detected.

^{b/}NS = Not sampled because mobile LNAPL was present.

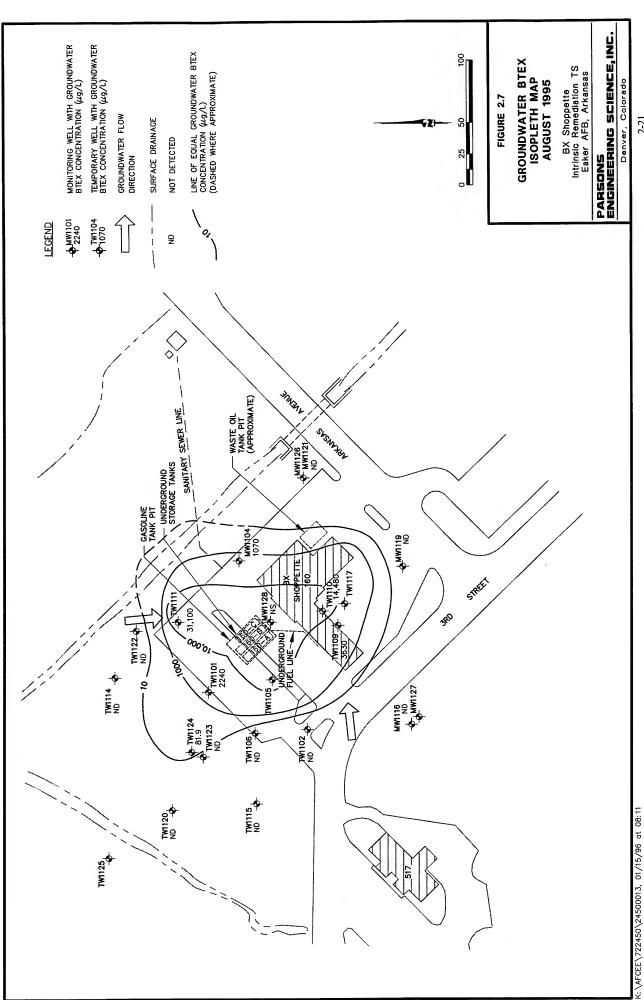
c/J = Estimated value.

near equilibrium BTEX concentrations, and therefore this well may also contain free product.

Elevated concentrations of dissolved BTEX in groundwater correspond with regions of mobile LNAPL and soil contamination (Figure 2.7). Total BTEX concentrations in excess of 10,000 µg/L were detected in 1995 groundwater samples collected from TW1110 and TW1111 (Halliburton NUS, 1995). The dissolved BTEX plume shape is relatively symmetrical; and it does not appear to be traveling away from the site. The convergent groundwater flow from the west and north, coupled with the flat hydraulic gradient appears to be acting to limit plume migration away from the BX Shoppette. The shape of the BTEX plume indicates relatively minor plume expansion to the northwest and southeast. This observed plume expansion may be the result of the BTEX plume traveling within the shallow aquifer in deeper, more conductive layers. At monitoring well cluster MW1123 and MW1124, BTEX compounds were not detected in groundwater samples from the shallower well (MW1123), but 81.9 µg/L total BTEX was detected in a groundwater sample from the deeper well, (MW1124). BTEX was not detected at the shallow downgradient well MW1121; and data from the deeper adjacent well, MW1126, were not available. The downgradient extent of dissolved BTEX in deeper aquifer zones has not been completely defined.

2.1.3.3 Geochemical Indicators of BTEX Degradation

Biodegradation of dissolved fuel hydrocarbons causes measurable changes in groundwater chemistry (Wiedemeier et al., 1995). Microorganisms obtain energy for cell production and maintenance by facilitating thermodynamically advantageous reduction/oxidation reactions involving the transfer of electrons from electron donors to available electron acceptors. This results in the oxidation of the electron donor and the



reduction of the electron acceptor. Electron donors at the BX Shoppette include natural organic carbon and fuel hydrocarbon compounds. Electron acceptors are elements or compounds that occur in relatively oxidized states, and include dissolved oxygen, nitrate, ferric iron, sulfate, and carbon dioxide.

During aerobic respiration of BTEX compounds, oxygen is used as an electron acceptor during microbial mineralization of carbon, and dissolved oxygen concentration decrease. In anaerobic systems where sulfate, nitrate, and ferric iron are available electron acceptors, the concentrations of sulfate and nitrate decrease, and the ferrous iron concentrations increase. In anaerobic conditions where carbon dioxide is used as an electron acceptor, it is reduced by methanogenic bacteria, and methane is produced. Groundwater geochemical data collected at 16 wells at the BX Shoppette by Halliburton NUS (1995) are summarized in Table 2.4. The data indicate that anaerobic biodegradation of BTEX through sulfate reduction may be occurring at the site. Aerobic biodegradation may be occurring, but data indicating this are not available.

Groundwater alkalinity is a measure of the ability of groundwater to buffer changes in pH caused by the generation of biologically generated acids. Increased alkalinity in the areas of groundwater BTEX contamination can occur in response to increased carbon dioxide concentrations, which are a product of BTEX biodegradation (Morell and Hering, 1993). Figure 2.8 presents an isopleth map of groundwater alkalinity in August 1995.

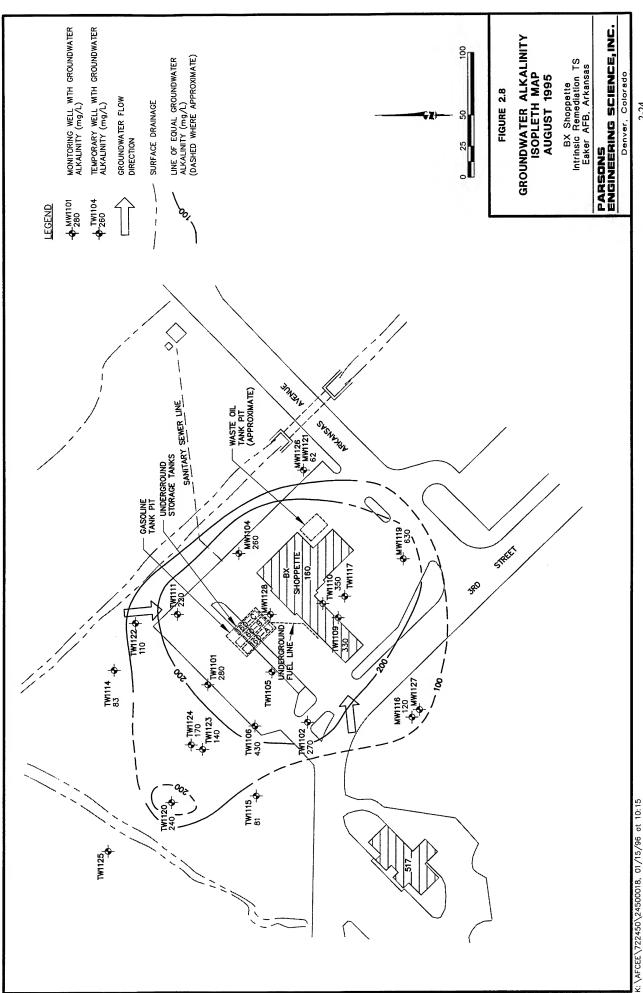
Sulfate also appears depleted in the areas corresponding to the BTEX plume (Figure 2.7) at the site, which suggests anaerobic BTEX biodegradation through sulfate reduction. Figure 2.9 is an isopleth map of August 1995 groundwater sulfate concentrations. In this anaerobic process, the BTEX compounds combine with sulfate and hydrogen to produce carbon dioxide, water, and sulfur. Comparison of Figures 2.8 and 2.9 with the

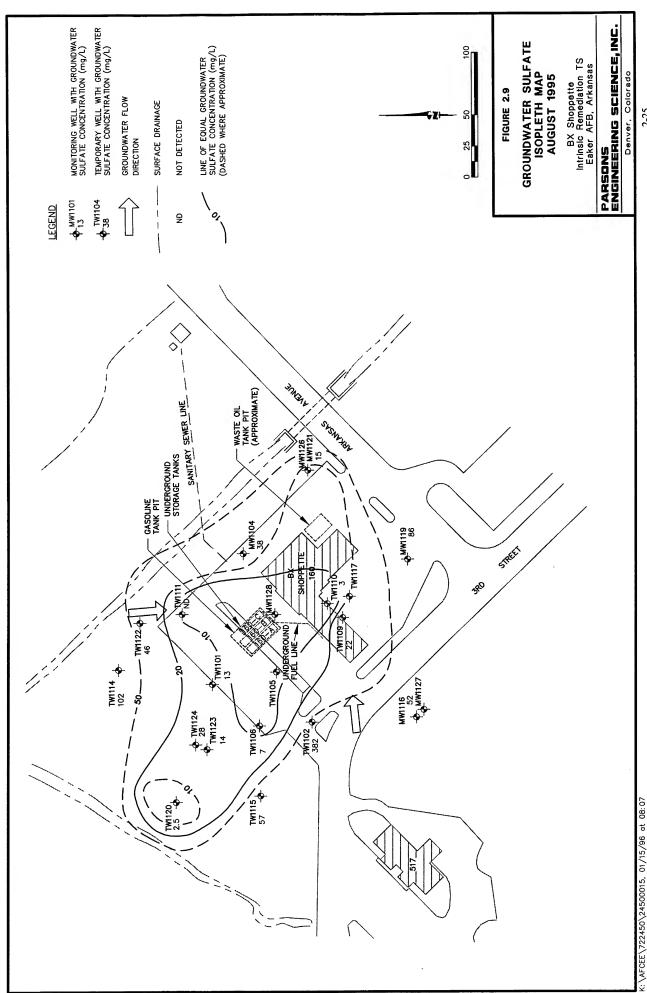
TABLE 2.4 SUMMARY OF GROUNDWATER GEOCHEMICAL DATA BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

	Nitrate	Alkalinity	Sulfate	Chloride
Well ID	(mg/L)	(mg/L)	(mg/L)	(mg/L)
TW1101	ND ^{a/}	280	13	5
TW1102	ND	270	382	5
MW1104	ND	260	38	7
TW1106	0.013	430	7	4
TW1109	0.1	330	22	36
MW1110	0.12	350	3	200
MW1111	0.03	220	ND	ND
MW1114	ND	83	102	24
MW1115	0.16	81	57	9
MW1116	0.02	120	52	3
MW1119	0.01	630	86	9
MW1120	ND	240	2.5	ND
MW1121	0.13	62	15	ND
MW1122	ND	110	46	ND
MW1123	ND	140	14	ND
MW1124	ND	170	28	11

a/ ND = Not detected.

Source: Halliburton NUS, 1995.





groundwater BTEX plume (Figure 2.7) shows graphically that the areas of relatively high alkalinity and reduced sulfate correspond with the BTEX plume. This is a preliminary indication that biodegradation of BTEX compounds is occurring at the site. Additional analysis of these and other attenuation processes will be provided in the TS report.

2.2 DEVELOPMENT OF CONCEPTUAL SITE MODEL

A CSM is a three-dimensional representation of a site's hydrogeologic system based on available geological, hydrological, climatological, and geochemical data. A CSM is developed to provide an understanding of the mechanisms controlling contaminant fate and transport and to identify additional data requirements. The model describes known and suspected sources of contamination, types of contamination, affected media, and contaminant migration pathways. The model also provides a foundation for formulating decisions regarding additional data collection activities and potential remedial actions. The CSM for the BX Shoppette will be used to aid in selecting additional data collection points and to identify appropriate data needs for quantifying and simulating groundwater flow characteristics and evidence of hydrocarbon degradation using groundwater flow and solute transport models.

Successful conceptual model development involves:

- Defining the problem to be solved;
- Integrating available data, including
 - Local geologic and topographic data,
 - Hydraulic data,
 - Site stratigraphic data, and

- Contaminant concentration and distribution data;
- Evaluating contaminant fate and transport characteristics;
- Identifying contaminant migration pathways;
- Identifying potential receptors and receptor exposure points; and
- Determining additional data requirements.

2.2.1 Predicting Intrinsic Remediation with Fate and Transport Models

The positive effect of natural attenuation processes (e.g., advection, dispersion, sorption, and biodegradation) on reducing the actual mass of fuel-related contamination dissolved in groundwater has been termed intrinsic remediation. Advantages of intrinsic remediation include: (1) contaminants are transformed to innocuous byproducts (e.g., carbon dioxide and water), not just transferred to another phase or location within the environment; (2) current pump-and-treat technologies are energy-intensive and generally not as effective in reducing residual contamination; (3) the process is nonintrusive and allows continuing use of infrastructure during remediation; (4) current engineered remedial technologies may pose a greater risk to potential receptors than intrinsic remediation because contaminants may be transferred into the atmosphere during remediation activities; and (5) intrinsic remediation is far less costly than conventional, engineered remedial technologies.

An accurate estimate of the potential for natural biodegradation of BTEX compounds in groundwater is important to consider when determining whether fuel hydrocarbon contamination presents a substantial threat to human health and the environment (through modeling), and when deciding what type of remedial alternative will be most cost effective in eliminating or abating such threats. Over the past two decades, numerous

laboratory and field studies have demonstrated that subsurface microorganisms can degrade a variety of hydrocarbons (Lee, 1988). This process occurs naturally when sufficient oxygen (or other electron acceptors) and nutrients are available in the groundwater. Hence, biodegradation is considered the most important natural attenuation process operating to remove BTEX contamination. The rate of natural biodegradation is generally limited by the lack of oxygen (or other electron acceptors) rather than by the lack of nutrients such as nitrogen or phosphorus. The supply of oxygen to unsaturated soil is constantly renewed by the vertical diffusion from the atmosphere. The supply of oxygen to a shallow, fuel-contaminated aquifer is constantly renewed by the influx of oxygenated, upgradient flow and precipitation recharge, and by the vertical diffusion of oxygen from the unsaturated soil zone into the groundwater (Borden and Bedient, 1986). The rate of natural biodegradation in unsaturated soil and shallow aquifers is largely dependent upon the rates at which oxygen and other electron acceptors enter the contaminated media.

By combining site-specific geochemical and chemical evidence, the potential for intrinsic remediation can be quantified through fate and transport modeling. Several analytical and numerical models are available for modeling the fate and transport of fuel hydrocarbons under the influence of advection, dispersion, sorption, and natural aerobic and anaerobic biodegradation. Analytical models may be used in conjunction with numerical models, such as Bioplume II, as appropriate. The Bioplume II numerical model is based upon the US Geological Survey (USGS) two-dimensional (2-D) solute transport model (Konikow and Bredehoeft, 1978), which has been modified to include a biodegradation component that is activated by a superimposed plume of dissolved oxygen. Bioplume II solves the USGS 2-D solute equation twice, once for hydrocarbon concentrations in the groundwater and once for a dissolved oxygen plume. The two

plumes are then combined using superimposition at every particle move to simulate biological reactions between fuel products and oxygen. As appropriate, biodegradation of contaminants by anaerobic processes is simulated using a first-order decay rate. The Bioplume II model will be used to predict the fate and transport of contaminants at the BX Shoppette site.

2.2.2 Initial Conceptual Site Model

The BX Shoppette hydrogeologic data were previously integrated to produce two hydrogeologic cross-sections of the site. Cross sections A - A' and B - B' (Figures 2.3 and 2.4) show the interbedded hydrostratigraphic units present at the site as determined from previous cross-sections and USACE (1995) CPT results. Figure 2.5 is a groundwater surface map prepared using March 1992 groundwater elevation data (Halliburton NUS, 1992)

The water table is present at approximately 7 to 12 feet bgs, in the silty sand and sandy clay deposits in the beneath the site. Groundwater flow converges in the site vicinity from the west and north, with gradients ranging from 0.016 ft/ft to 0.0017 ft/ft. On the basis of the available data, Parsons ES will model the site as an unconfined, fine-grained sand aquifer interbedded with clay sediments. The aquifer may become confined with depth due to overlying clay units, and the CSM will be modified as necessary as additional site hydrogeologic data become available. Vertical migration of site contaminants in groundwater will be further investigated in the source area near monitoring well TW1105 to evaluate the spread of dissolved BTEX in different aquifer subunits.

Mobile LNAPL is believed to be present at the BX Shoppette, and it may be necessary to use the fuel/water partitioning models of Bruce *et al.* (1991) or Cline *et al.* (1991) to provide a conservative source term to model the partitioning of BTEX from the mobile LNAPL into the groundwater. In order to use one of these models, samples of free product will be collected and analyzed for mass fraction of BTEX. Parsons ES also will collect additional groundwater samples from immediately below the LNAPL layer. Mobile LNAPL has been observed in well TW1105; the lateral extent of free product has not been determined. Figure 2.7 shows the extent of BTEX groundwater contamination at the site. Information from this map and historical soil contamination data for the site (Figure 2.6) will be used to select the locations of new monitoring wells to fully define the extents of the mobile LNAPL and dissolved BTEX plumes at the BX Shoppette.

Because of it solubility and relative toxicity, benzene is the primary chemical of interest in groundwater at the BX Shoppette. However, the synergistic effects of all of the BTEX compounds on attenuation rates make site data on all of the BTEX compounds important. Therefore, the BTEX compounds will be the primary focus of this intrinsic remediation TS. The Bioplume II model will be used to simulate the degradation of these chemicals at the BX Shoppette and to predict the concentrations and extent of the contaminant plumes in the groundwater over time.

Dissolved BTEX compounds at the site are expected to continue to leach from contaminated soils containing fuel residuals, to dissolve from mobile LNAPL into the groundwater, and to migrate downgradient as a dissolved contaminant plume. In addition to the effects of mass transport mechanisms (volatilization, dispersion, diffusion, and adsorption), these dissolved contaminants will likely be removed from the groundwater system by destructive attenuation mechanisms, such as biodegradation. The effects of

these fate and transport processes on the dissolved BTEX plume will be investigated using the quantitative groundwater analytical data and the solute transport models. Data collection and analysis requirements are discussed in Section 3 of this work plan.

2.2.3 Potential Pathways and Receptors

Potential preferential contaminant migration pathways such as groundwater discharge points and subsurface utility corridors (artificial conduits) will be identified during the field work phase of this project. The primary potential migration path for contaminants at the BX Shoppette is from the residual LNAPL in contaminated soils and mobile LNAPL at the site into the groundwater, and from the groundwater to potential downgradient receptors via ingestion or incidental contact.

Shallow groundwater beneath the site flows toward the east. There are no known operating potable or nonpotable water wells (other than monitoring wells) located within 1 mile downgradient or crossgradient from the site. Surface drainage by overland flow from the site discharges into the adjacent surface drainages and flows into Ditch 25, north of the site. Shallow soil contamination at the site is located at the gasoline tank pit and fuel trench, and is not expected to impact surface water quality due to the asphalt cover.

The potential for exposure to contaminated groundwater originating from the site through ingestion is low because Base access is restricted and Base drinking water does not come from wells located downgradient from the site and within the surfical aquifer. Pavement at the site prevents surface water/soil contact. However, fuel vapors could migrate into the BX Shoppette building. There are four deep-aquifer potable- water wells located approximately 2.3 miles southeast of the Base that are used by the city of Blytheville. Site contaminants are not expected to migrate to any of these drinking water

wells. However, determining the potential impacts from shallow groundwater discharge into the adjacent drainage ditch will be of primary importance for assessing the feasibility of intrinsic remediation at the BX Shoppette and will be considered in greater detail once additional site data essential for the evaluation of intrinsic remediation have been collected.

SECTION 3

COLLECTION OF ADDITIONAL DATA

To complete the TS and to evaluate whether natural attenuation of fuel-related contaminants is occurring, additional site-specific hydrogeologic data will be collected. The physical and chemical hydrogeologic parameters listed below will be determined during the field work phase of the TS.

Physical hydrogeologic characteristics include:

- Depth from measurement datum to the groundwater surface in existing monitoring wells;
- Locations of potential groundwater recharge and discharge areas;
- Locations of downgradient wells and their uses;
- Hydraulic conductivity through slug tests, as required;
- Estimation of dispersivity, where possible;
- Stratigraphic analysis of subsurface media;
- Groundwater temperature; and
- Determination of extent and thickness of mobile- and residual-LNAPL.

Chemical hydrogeologic characteristics include:

• Dissolved oxygen (DO) concentrations;

- Specific conductance;
- pH;
- Chemical analysis of mobile LNAPL to determine mass fraction of BTEX; and
- Additional chemical analysis of groundwater and soil for the parameters listed in Table 3.1.

Field work described in this work plan in support of the TS will be completed in March 1996. The objective of field work will be to define the extent of residual and mobile LNAPL hydrocarbon contamination using CPT in conjunction with LIF testing and soil, groundwater, and mobile LNAPL sampling. Areas of residual and free-phase hydrocarbon contamination were sampled during field operations conducted in 1991, 1992, and 1995; however, additional LIF testing will be required during the upcoming field operations to better define the extent of residual and mobile LNAPL.

The following sections describe the procedures that will be followed when performing field investigations and collecting site-specific data. The CPT/LIF system is described in Section 3.1. Procedures for soil sample collection to verify CPT/LIF data are described in Section 3.1.2. Procedures for the installation of new monitoring points are described in Section 3.2. Procedures for sampling existing groundwater monitoring wells and newly installed groundwater monitoring points are described in Section 3.3, and procedures for the measurement of aquifer parameters (e.g., hydraulic conductivity) are described in Section 3.4.

TABLE 3.1 ANALYTICAL PROTOCOL FOR GROUND WATER AND SOIL SAMPLES BX SHOPPETTE

INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

MATRIX Analyte	METHOD	FIELD (F) OR ANALYTICAL LABORATORY (L
WATER		
Total Iron	Colorimetric, Hach Method 8008 (or similar)	F
Ferrous Iron (Fe+2)	Colorimetric, Hach Method 8146 (or similar)	F
Ferric Iron (Fe+3)	Difference between total and ferrous iron	F
Manganese	Colorimetric, Hach Method 8034 (or similar)	F
Sulfide	Colorimetric, Hach Method 8131 (or similar)	F
Sulfate	Colorimetric, Hach Method 8051 (or similar)	F
Nitrate	Titrimetric, Hach Method 8039 (or similar)	F
Nitrite	Titrimetric, Hach Method 8507 (or similar)	F
Redox Potential	A2580B, direct-reading meter	F
Oxygen	Direct-reading meter	F
pН	E150.1/SW9040, direct-reading meter	F
Conductivity	E120.1/SW9050, direct-reading meter	F
Temperature	E170.1	F
Alkalinity (Carbonate [CO3-2] and Bicarbonate [HCO3-1])	Titrimetric, Hach Method 8221 (or similar)	F
Carbon Dioxide	CHEMetrics Method 4500	F
Nitrate	E300 or SW9056	L
Nitrite	E300 or SW9056	L
Chloride	E300 or SW9056	L
Sulfate	E300 or SW9056	L
Alkalinity	E150.1	L
Methane	RSKSOP 175 ^{a/}	L
Total Organic Carbon	A5310C	L
Aromatic Hydrocarbons (Including Trimethylbenzene	SW8020	L
and Tetramethylbenzene)		
Total Hydrocarbons	SW8015, modified for gasoline-range organics	L
FREE PRODUCT		
Free Product	GS/MS, Direct Injection	L
son		-
Total Organic Carbon	SW9060	L
Moisture	ASTM D-2216	L
Aromatic Hydrocarbons	SW8020	L
Total Hydrocarbons	SW8015, modified for gasoline-range organics	L

^{a/}RSKSOP = Robert S. Kerr Laboratory standard operating procedure.

3.1 CONE PENETROMETRY

Subsurface conditions at the site will be characterized using CPT coupled with LIF. Cone penetrometry is an expeditious and effective means of analyzing the stratigraphy of a site by measuring resistance against the conical probe of the penetrometer as it is pushed into the subsurface. Stratigraphy is determined from a correlation of the point stress at the probe tip and frictional stress on the side of the cone. Soil cores also are collected to correlate the CPT readings to the lithologies present at the site.

CPT will be conducted using the USACE's cone penetrometer truck. This equipment consists of an instrument probe that is forced into the ground using a hydraulic load frame mounted on a heavy truck, with the weight of the truck providing the necessary reaction mass. The penetrometer equipment is housed in a stainless steel, dual-compartment body mounted on a 43,000-pound, triple-axle Kenworth[®] truck chassis powered by a turbocharged diesel engine. The weight of the truck and equipment is used as ballast to achieve the overall push capability of 39,000 pounds. This push capacity may be limited in tight soils by the structural bending capacity of the 1.40-inch outside-diameter (OD) push rods, rather than by the weight of the truck. The current 39,000-pound limitation is intended to minimize the possibility of push-rod buckling. Penetration force is supplied by a pair of large hydraulic cylinders bolted to the truck frame.

The penetrometer probe is of standard dimensions, having a 1.40-inch OD, a 60-degree conical point with sacrificial tip, and an 8.0-inch-long by 1.40-inch OD friction sleeve. Inside the probe, two load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Each load cell is a cylinder of uniform cross-section that is instrumented with four strain gauges in a full-bridge circuit. Forces are sensed by the load cells, and the data are transmitted from the probe

assembly via a cable running through the push tubes. The analog data are digitized, recorded, and plotted by computer in the penetrometry truck. A grout tube also runs down the push cylinder to allow the emplacement of cement grout in order to seal the CPT hole. The USACE CPT is not equipped to monitor pore pressure; therefore, the location of the water table will not be measured using the CPT apparatus. However, evaluation of point and sleeve stresses can often provide an estimated depth to groundwater. The penetrometer is usually advanced vertically into the soil at a constant rate of 2 cm/s, although this rate must sometimes be reduced, such as when hard layers are encountered. Penetration, dissipation, and resistivity data will be used to determine lithologic layering as it is encountered in the field.

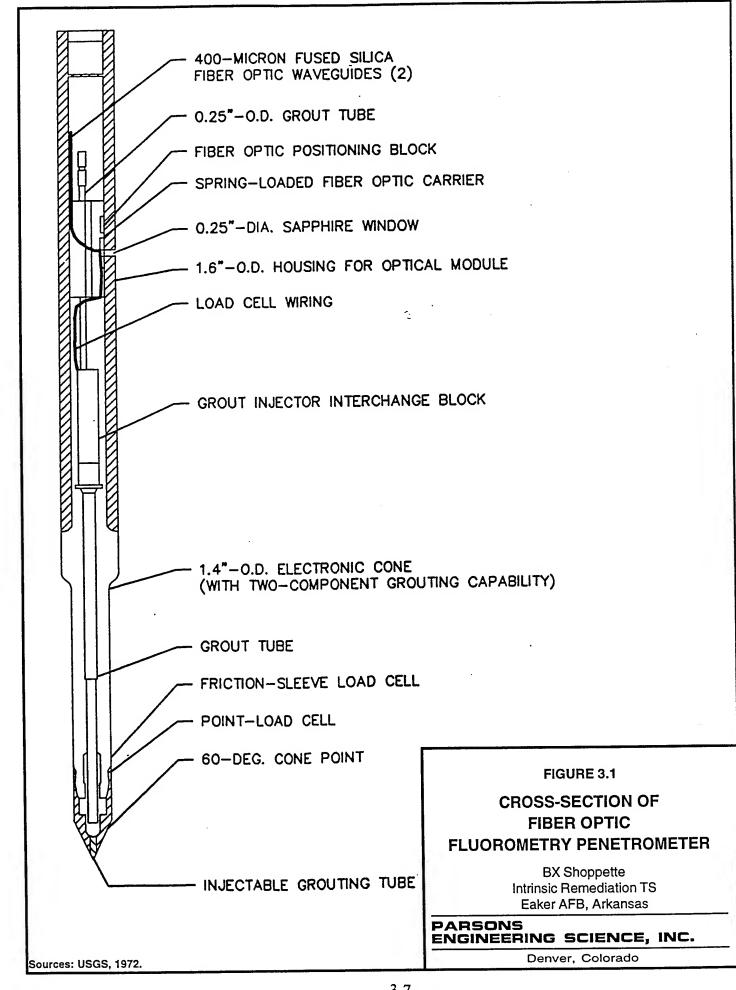
The known propensity of aromatic hydrocarbons to fluoresce under ultraviolet wavelengths has allowed the use of LIF technology, in conjunction with CPT technology, to detect soil characteristics and hydrocarbon contamination simultaneously. The LIF is not capable of detecting chlorinated solvents. The LIF is only useful for more grossly contaminated areas with mobile LNAPL or significant residual contamination The lower range of detection is greater than 100 mg/kg total concentrations. hydrocarbons. The LIF system has a 0.25-inch sapphire window in the side of the cone that allows a laser to scan the soil for fluorescent compounds as the LIF penetrometer rod Assuming that aromatic hydrocarbons are simultaneously pushes through soil. solvenated with other fuel-hydrocarbon constituents, the magnitude of aromatic fluorescence is indicative of hydrocarbon contamination in a soil matrix. Fiber optic cables connected to the laser spectrometer and a 6-pair electrical conductor connected to the CPT data acquisition system, are routed through the interior of the push tubes to the CPT probe.

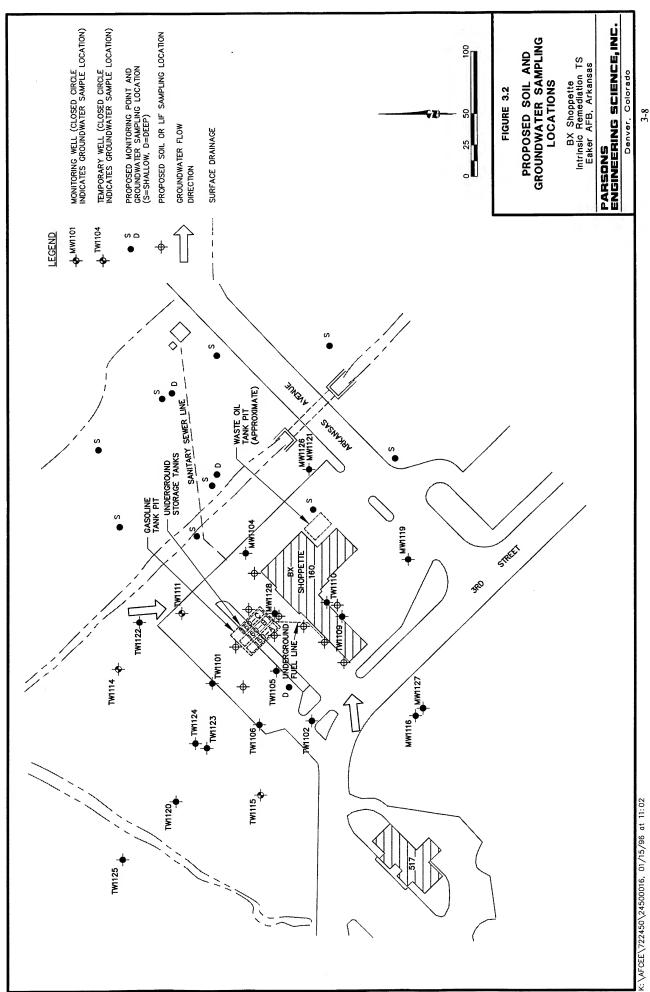
The basic components of the LIF instrument are a nitrogen laser, a fiber optic probe, a monochromator for wavelength resolution of the return fluorescence, a photomultiplier tube to convert photons into an electrical signal, a digital oscilloscope for waveform capture, and a control computer. The fiber optic probe for the cone penetrometer consists of delivery and collection optical fibers, a protective sheath, a fiber optic mount within the cone, and a 0.25-inch sapphire window (Figure 3.1).

The results of each CPT/LIF push will be available 2 or 3 minutes after the completion of each hole. Graphs showing cone resistance, sleeve friction, soil classification, fluorescence intensity, and wavelength will be plotted by USACE personnel at the conclusion of each penetration and presented to the Parsons ES field scientist in order to allow investigative decisions to be based on the most current information.

3.1.1 CPT/LIF Testing Strategy

The purpose of the CPT/LIF testing at the site is to determine subsurface stratigraphy and to better define the areal and vertical extent of residual fuel hydrocarbons in the unsaturated zone and free-phase hydrocarbons in the site groundwater. The CPT will be pushed from ground surface to below fluorescing contamination, refusal, or up to 60 feet bgs, depending on contaminant distribution and subsurface conditions. In order to define the edges of mobile LNAPL contamination, CPT/LIF points be will placed at the locations shown on Figure 3.2. The majority of the points will be used to better define the vertical and lateral extent of the mobile LNAPL layer that has been observed in monitoring well TW1105. Points will be placed at the estimated outer extent of the LNAPL to establish a known mobile LNAPL plume location. CPT/LIF points also will be placed closer or further away, as necessary, to define the extent of the layer. Other CPT/LIF sites are located downgradient from the site across the drainage ditch and will





be used to install monitoring points to collect groundwater BTEX and electron acceptor data. One CPT point will be located north of the site to serve as a background monitoring point. The proposed CPT locations will be repositioned, as needed, based on data collected at the time of field sampling.

Base personnel will coordinate with the USACE to identify the location of all utility lines, USTs, fuel lines, and any other underground infrastructure prior to any CPT activities. All necessary digging permits will be obtained by Base and the USACE personnel prior to mobilizing to the field. Digging permits issued in 1995 for previous USACE (1995) work at the BX Shoppette may be used if Base authorities agree. Base personnel also will coordinate with USACE to acquire drilling and monitoring point installation permits for the proposed CPT/LIF locations indicated in Figure 3.2.

3.1.2 Soil Sampling and Analysis

To check the CPT soil classifications and to calibrate the LIF data, soil samples from discrete intervals will be collected at the site. Soil samples will be collected from varied soil units (if present) within source areas and visibly contaminated areas, at the fringe of the identified residual or mobile LNAPL hydrocarbon plume, and outside of the LNAPL plume. Soil samples will be collected at up to 13 locations. Figure 3.2 shows the locations for 10 proposed sampling locations. In addition, a minimum of three samples will be collected from background or uncontaminated downgradient locations for total organic carbon (TOC) analysis. These sampling locations will be determined by the field scientist based on field data collected using the CPT.

When soil samples are collected using the CPT, a Hoggen-Toggler[®] attachment for the CPT push rods will be used. A Hoggen-Toggler[®] sampler is a device used to collect undisturbed soil samples at any desired depth within the range of the driving apparatus.

The sampler is coupled to the penetrometer rod and pushed into the soil with the CPT truck. With the Hoggen-Toggler® cone in the closed position, soil is prevented from entering the sampling tube until the desired depth is achieved. When the sampler has been pushed to the depth at which the soil sample is to be taken, the sampling unit is raised a few inches and the Hoggen-Toggler® apparatus is opened. The open Hoggen-Toggler® is then pushed to fill with soil, then pulled from the ground as quickly as possible. The Hoggen-Toggler® sampling apparatus allows collection of 8-inch-long by 1-inch inside-diameter (ID) continuous samples. Recovery efficiencies for samples in saturated or sandy soils are often reduced, or the samples are compromised, because of spillage of the soil from the device after extraction. To mitigate this problem, soil samples will be compressed *in situ* with the penetrometer and Hoggen-Toggler® assembly to expel the pore water before extraction.

When the Hoggen-Toggler[®] sampling technique described above is ineffective or unable to efficiently provide sufficient soil volumes for the characterization of the site, soil samples will be obtained using a hand auger or similar method judged acceptable by the Parsons ES field scientist. Procedures will be modified, if necessary, to ensure good sample recovery.

Recovered soil will be placed in analyte-appropriate sample containers (Appendix A) and shipped to an approved analytical laboratory for analysis of BTEX, TOC, moisture content, and TPH by the analytical methods listed in Table 3.1. The lithology of recovered soil will be recorded for comparison and correlation with CPT results.

The Parsons ES field scientist will be responsible for observing all field investigation activities, maintaining a detailed descriptive log of all subsurface materials recovered during soil coring, photographing representative samples, and properly labeling and

storing samples. An example of the proposed geologic boring log form is presented in Figure 3.3. The descriptive log will contain the following information:

- Sample interval (top and bottom depth);
- Sample recovery;
- Presence or absence of contamination based on visual observations, odor, and photoionization detector (PID) headspace measurements;
- Lithologic description, including relative density, color, major textural
 constituents, minor constituents, porosity, relative moisture content, plasticity of
 fines, cohesiveness, grain size, structure or stratification, relative permeability, and
 any other significant observations; and
- Depths of lithologic contacts and/or significant textural changes measured and recorded to the nearest 0.1 foot.

3.1.3 CPT Locations and Datum Survey

The horizontal location of all CPT/LIF testing locations relative to established Base coordinates will be measured by a licensed surveyor. Horizontal coordinates will be measured to the nearest 0.1 foot. The elevation of the ground surface will also be measured to the nearest 0.1 foot relative to a USGS msl datum. Sample location and other relevant site information for the soil cores collected for verification purposes will be recorded by the Parsons ES field scientist.

GEOLOGIC BORING LOG Sheet 1 of 1 _____ DATE SPUD: _____ CONTRACTOR: _ BORING NO .: ____ AFCEE CPT ____RIG TYPE: _____ DATE CMPL.: CLIENT: 722450.15 DRLG METHOD: CPT ELEVATION: JOB NO.: LOCATION: EAKER AFB BORING DIA.: _____ TEMP: GEOLOGIST: ______DRLG FLUID: NONE WEATHER: COMMENTS: _____

Elev	Depth	Pro-	US		Sc	ample	Sample	Penet		WKSPC	TOTAL	TPH
(ft)	(ft)	file	cs	Geologic Description	No.	Depth (ft)	Туре	Res	PID(ppm)	PID(ppm)	TOTAL BTEX(ppm)	(ppm)
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NOTES

bgs - Below Ground Surface D - DRIVE

GS - Ground Surface

TOC — Top of Casing

NS — Not Sampled

SAA — Same As Above

SAMPLE TYPE

C - CORE

G - GRAB

▼ Water level drilled

PARSONS

ENGINEERING SCIENCE, INC.

FIGURE 3.3

GEOLOGIC BORING LOG

BX Shoppette Intrinsic Remediation TS

Eaker AFB, Arkansas

Denver, Colorado

3.1.4 Site Restoration

After sampling is complete, each CPT location will be restored as closely to its original condition as possible. Any test holes remaining open after extraction of the penetrometer rod will be sealed with hydrated bentonite chips, pellets, or grout to eliminate the creation or enhancement of contaminant migration pathways to the groundwater. Soil sampling using the CPT creates minor volumes of soil waste. The accumulated volume of soil waste generated during field activities will be collected in 55-gallon drums or buckets and disposed of at the soil landfarm located on Base.

3.1.5 Equipment Decontamination Procedures

The CPT push rods will be cleaned with potable water using the USACE CPT steam-cleaning system (rod cleaner) as the rods are withdrawn from the ground. A vacuum system located beneath the CPT truck will be used to recover rinseate. Use of this system results in nearly 100-percent recovery of steam-cleaning rinseate from the rod cleaner. Rinseate is generated only as the rods move past the cleaner, thereby minimizing liquid waste generation. Care will be taken not to apply the pressurized steam to the LIF module, which will be decontaminated by hand. Rinseate will be collected in 55-gallon drums. USACE personnel will arrange for final disposal of the containerized rinseate. USACE personnel are responsible for sampling the contents of the drums to identify any hazardous constituents before the drums are transported to an appropriate disposal facility. Other downhole and sampling equipment will be decontaminated by steam cleaning or by the procedures specified in Section 3.3.2.1.

Potable water to be used in CPT equipment cleaning, decontamination, or grouting will be obtained from one of the Base water supplies. Water use approval will be verified by contacting the appropriate facility personnel. The field scientist will make the final 3-13

determination as to the suitability of site water for these activities. Precautions will be taken to minimize any impact on the surrounding area that might result from decontamination operations.

3.2 PERMANENT MONITORING POINT INSTALLATION

To further characterize the hydrogeologic conditions of the shallow subsurface, up to 12 groundwater monitoring points may be installed at the site to supplement the existing site monitoring wells. The following sections describe the proposed monitoring point locations and completion intervals, monitoring point installation, monitoring point development, and equipment decontamination procedures.

3.2.1 Monitoring Point Locations and Completion Intervals

The locations of 12 proposed groundwater monitoring points are identified for the BX Shoppette site on Figure 3.2. The proposed locations for the new monitoring points were determined from a review of data gathered during previous site activities. Monitoring point locations were selected to provide hydrogeologic data necessary for successful implementation of the Bioplume II model and to monitor potential fuel hydrocarbon migration from the site. Monitoring point locations were selected to define three aspects of the site: 1) the areal extent of residual and mobile LNAPL contamination, 2) the horizontal and vertical distribution of dissolved BTEX, and 3) the hydrogeology and groundwater flow direction at the site. The proposed locations shown on Figure 3.2 may be modified in the field as a result of encountered field conditions and acquired field data.

Several shallow monitoring points are proposed to define the areal extent of contamination. Eight shallow monitoring points are proposed to be located east of the site to define the lateral extent of the dissolved contaminant migration. At least two deep

monitoring points will be located along the downgradient contaminant flow path to define the vertical extent of BTEX compounds. Another deep point will be placed adjacent to TW1105 to determine if any vertical migration of BTEX is occurring within the mobile LNAPL source area. The final proposed point will be located downgradient of the site near the intersection of the Arkansas and Third Street. Data from this monitoring point will provide additional information on electron acceptor concentrations and define the extent of the BTEX plume.

Screened intervals for shallow monitoring points will extend from approximately 1 foot above the water table to 2 feet below the water table. Deep points will be placed on the basis of lithology, or approximately 10 feet below the next shallowest monitoring point (in the absence of significant lithologic changes). All monitoring points will be installed with 1 meter of screen. The proposed screened intervals of 1 meter will help mitigate the dilution of water samples from potential vertical mixing of contaminated and uncontaminated groundwater in the monitoring point casing, and will give important information on the nature of vertical hydraulic gradients in the area. Adjustments of the depth and length of the screened interval of the monitoring points may be necessary in response to actual aquifer conditions and contaminant stratification identified during LIF/CPT testing.

3.2.2 Monitoring Point Installation Procedures

This section describes the procedures to be used for installation of new groundwater monitoring points. All new monitoring points will be constructed of 0.75-inch OD/0.5-inch ID polyvinyl chloride (PVC) casing placed with a CPT pushrod using equipment described in Section 3.1.

3.2.2.1 Pre-Placement Activities

All necessary digging, drilling, and groundwater monitoring point installation permits will be obtained prior to mobilizing to the field. In addition, all utility lines will be located, and proposed drilling locations will be cleared prior to any intrusive activities. Responsibilities for these permits and clearances are discussed in Section 3.1.1.

Water to be used in monitoring point installation and equipment cleaning will be obtained from one of the Base water supplies. Water use approval will be verified by contacting the appropriate facility personnel. The field scientist will make the final determination as to the suitability of water for these activities.

3.2.2.2 Groundwater Monitoring Point Installation

3.2.2.2.1 Monitoring Point Materials Decontamination

Monitoring point completion materials will be inspected by the field scientist and determined to be clean and acceptable prior to use. If not factory sealed, casing, screen, and casing plugs and caps will be cleaned prior to use with a high-pressure, steam/hot-water cleaner using approved water. Materials that cannot be cleaned to the satisfaction of the field scientist will not be used.

3.2.2.2.2 Monitoring Point Screen and Casing

Groundwater monitoring points will be installed by attaching 0.75-inch OD/0.5-inch ID PVC casing and screen to a sacrificial tip and threading the casing/screen through the penetrometer pushrod. As the pushrod is pressed into the ground, new 0.75-inch OD/0.5-inch ID PVC casing will be continuously attached until the desired depth is reached and a fully cased monitoring point is created. Data collection devices such as CPT and LIF will not be used during monitoring point placement; however, a CPT test will be performed at

each monitoring point location prior to monitoring point placement in order to select desired screen depths.

Monitoring point casing and screens will be constructed of flush-threaded, Schedule 40 PVC. The screens will be factory slotted with 0.01-inch openings. Casing joints will not be glued. The PVC top cap for monitoring points completed at or below grade will not be vented in order to minimize the potential for surface water entering the point.

The field scientist will verify and record the total depth of the monitoring point, the lengths of all casing sections, and the depth to the top of all monitoring point completion materials. All lengths and depths will be recorded to the nearest 0.1 foot. Monitoring point construction details will be noted on a Monitoring Point Installation Record form (Figure 3.4). This information will become part of the permanent field record for the site.

3.2.2.3 Above-Grade and At-Grade Well Completion

Each monitoring point will be completed with an at-grade protective cover. In areas where pavement is present, the at-grade cover will be cemented in place using concrete blended to the existing pavement; otherwise, a concrete pad will be installed around the monitoring point. The concrete immediately surrounding the monitoring point will be sloped gently away from the protective casing to facilitate runoff during precipitation events.

3.2.2.4 Monitoring Point Development

New monitoring points will be developed prior to sampling. Development removes sediment from inside the monitoring point casing and flushes fines from the portion of the formation adjacent to the monitoring point screen.

MONITORING POINT INSTALLATION RECORD					
JOB NAME WELL NUMBER					
JOB NUMBER 722450.15 INSTALLATION DATE					
DATUM ELEVATION GROUND SURFACE ELEVATION					
DATUM FOR WATER LEVEL MEASUREMENT					
SCREEN DIAMETER & MATERIAL SLOT SIZE					
RISER DIAMETER & MATERIAL					
GRANULAR BACKFILL MATERIAL					
DRILLING METHOD	• •				
DRILLING METHOD	DIVIDENIA CONTINUON				
/VE	NTED CAP				
GROUND SURFACE —	OVER				
CONCRETE					
THREADED COUPLING					
	LENGTH OF SOLID				
	RISER:				
SOLID RISER	TOTAL DEPTH				
SOLID RISER	LENGTH OF OF MONITORING				
	SCREEN:POINT:				
i					
SCREEN —					
SCREEN —	SCREEN SLOT				
	SIZE: 0.01"				
CAP	LENOTH OF BACKETTED				
	LENGTH OF BACKFILLED BOREHOLE:				
	BACKFILLED WITH:				
	FIGURE 3.4				
NOT TO SCALE	MONITORING POINT				
	INSTALLATION RECORD				
	DV Channella				
	BX Shoppette Intrinsic Remediation TS				
STABILIZED WATER LEVEL FEET	Eaker AFB, Arkansas				
BELOW DATUM. PARSONS					
	ENGINEERING SCIENCE, INC.				
	Denver, Colorado				

Monitoring point development will be accomplished using a peristaltic pump with dedicated tubing provided by Parsons ES. The pump tubing will be regularly lowered to the bottom of the monitoring point so that fines which have accumulated in the bottom are agitated and removed from the monitoring point.

Development will be continued until a minimum 10 casing volumes of water has been removed from the monitoring point and until pH, temperature, specific conductivity, DO, and water clarity (turbidity) stabilize. If the water remains turbid, monitoring point development will continue until the turbidity of the water produced has been stable after the removal of several casing volumes.

A monitoring point development record will be maintained for each point. The monitoring point development record will be completed in the field by the field scientist. Figure 3.5 is an example of the monitoring point development record. Development records will include:

- Monitoring point number;
- Date and time of development;
- Development method;
- Predevelopment water level and monitoring point depth;
- Volume of water produced;
- Description of water produced;
- Postdevelopment water level and monitoring point depth; and
- Field analytical measurements, including pH and specific conductivity.

Page_of_	
:	
	•
f Well:	
ng	
	-
	:
ng	

Job Name: AFCEE Natural Attenuation
by TH\MVDate
Measurement Datum
Time (Start):
Total Depth of Well:
Clear Cloudy Weak Moderate Strong e Material
Temperature(°F °C)S/cm)
·
Time (Finish):
Total Depth of Well:
Clear Cloudy Weak Moderate Strong e Material Temperature(°F °C)
S/cm)

Comments:

FIGURE 3.5

MONITORING POINT DEVELOPMENT RECORD

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

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Development waters from monitoring points will be collected in buckets at the site because low volumes of purge water are expected. Samples of the development water will be collected in 500- to 1,000-milliliter (mL) plastic or glass jars that are capped with foil and set at ambient temperatures for 15 minutes. A headspace reading of the development water sample will be taken with an organic vapor meter (OVM). Development water with a headspace reading less than 5 parts per million, volume (ppmv) will be released on the ground surface at the site. Development waters with organic vapor headspace readings above 5 ppmv will be collected and transported to the on-base landfarm for disposal.

3.2.2.5 Water Level Measurements

Water levels at existing monitoring wells and newly installed monitoring points will be measured within a short time period so that the water level data are comparable. The depth to water below the measurement datum will be measured to the nearest 0.01 foot using an electric water level probe.

3.2.2.6 Monitoring Point Location and Datum Survey

The location and elevation of the new monitoring points will be surveyed soon after point completion. The horizontal location will be measured relative to established Base coordinates. Horizontal coordinates will be measured to the nearest 0.1 foot. The elevation of the ground surface adjacent to the monitoring point casing and the measurement datum elevation (top of PVC casing) will be measured relative to the USGS msl datum. The ground surface elevation will be measured to the nearest 0.1 foot and the measurement datum, outer casing, and surveyor's pin (if present) elevation will be measured to the nearest 0.01 foot.

3.2.3 Site Restoration

After monitoring point installation and sampling is complete, each site will be restored around the finished monitoring point as closely as possible to its original condition. Both clean and contaminated development waters and sampling purge waters will be stored in 55-gallon drums or buckets. Development water will be disposed of as specified in Section 3.2.2.4.

3.3 GROUNDWATER SAMPLING

This section describes the scope of work required for collection of groundwater quality samples at existing groundwater monitoring wells, monitoring points, and well points. This section also details grab-sampling using peristaltic pumps inserted into the probe rods themselves to obtain single, discrete groundwater samples, if required. All groundwater samples will be obtained using a peristaltic pump and dedicated high-density polyethylene tubing (HDPE) where groundwater levels permit. In order to maintain a high degree of QC during this sampling event, the procedures described in the following sections will be followed.

Sampling will be conducted by qualified scientists and technicians trained in the conduct of groundwater sampling, records documentation, and chain-of-custody procedures. In addition, sampling personnel will have thoroughly reviewed this work plan prior to sample acquisition and will have a copy of the work plan available on site for reference.

The following list summarizes the activities that will occur during groundwater sampling:

Assembly and preparation of equipment and supplies;

- Inspection of the monitoring well or monitoring point integrity including:
 - Protective cover, cap, and lock,
 - External surface seal and pad,
 - Monitoring point ca, and datum reference, and
 - Internal surface seal;
- Groundwater sampling, including
 - Water level and product thickness measurements,
 - Visual inspection of sample water,
 - Monitoring point casing evacuation, and
 - Sample collection;
- Sample preservation and shipment, including
 - Sample preparation,
 - Onsite measurement of physical parameters, and
 - Sample labeling;
- Completion of sampling records: and
- Sample disposition.

Detailed groundwater sampling and sample handling procedures are presented in following sections.

3.3.1 Groundwater Sampling Strategy

Groundwater samples will be collected from previously installed monitoring wells and from monitoring points installed during this project. The existing wells and proposed monitoring point locations for sampling are identified in the following sections.

With the exception of wells TW1114 and TW1115, existing monitoring wells TW1101 through MW1128 will be sampled. At monitoring wells MW1124, MW1125, MW1126, MW1127, and MW1128, groundwater samples will be collected from the medium-grained sand unit located approximately 26 feet bgs. Shallow groundwater samples will be collected from the remaining wells. In addition, samples will be collected from the newly installed monitoring points.

3.3.2 Preparation for Sampling

All equipment to be used for sampling will be assembled and properly cleaned and calibrated (if required) prior to arriving in the field. In addition, all record-keeping materials will be gathered prior to leaving the office.

3.3.2.1 Equipment Cleaning

All portions of sampling and test equipment that will contact the sample matrix will be thoroughly cleaned before each use. This includes the CPT rods, water level probe and cable, lifting line, test equipment for onsite use, and other equipment or portions thereof that will contact the samples. Based on the types of sample analyses to be conducted, the following cleaning protocol will be used:

- Wash with potable water and phosphate-free laboratory detergent (HP-II detergent solutions, as appropriate);
- Rinse with potable water;

- Rinse with distilled or deionized water;
- Rinse with isopropyl alcohol; and,
- Air dry the equipment prior to use.

Any deviations from these procedures will be documented in the field scientist's field notebook and on the Groundwater Sampling Record (Figure 3.6).

If precleaned disposable sampling equipment is used, the cleaning protocol specified above will not be required. Laboratory-supplied sample containers will be cleaned and sealed by the laboratory. The type of container provided and the method of container decontamination will be documented in the laboratory's permanent record of the sampling event.

3.3.2.2 Equipment Calibration

As required, field analytical equipment will be calibrated according to the manufacturers' specifications prior to field use. This applies to equipment used for onsite measurements of oxygen, carbon dioxide, pH, electrical conductivity, temperature, alkalinity, reduction/oxidation potential, sulfate, sulfide, nitrate, nitrite, ferrous iron (Fe^{2+}) , total iron, ferric iron $[Fe^{3+} = (total iron) - Fe^{2+}]$, and manganese.

3.3.3 Sampling Procedures

Special care will be taken to prevent contamination of the groundwater and extracted samples. The two primary ways in which sample contamination can occur are through contact with improperly cleaned equipment and through cross-contamination due to insufficient cleaning of equipment between wells and monitoring points. To prevent such contamination, the water level probe and cable used to determine static water levels and

GROUND	WATER SAMPLING RECORD - MONITORING WELL	
		(number)
REASON I	FOR SAMPLING: [] Regular Sampling; [] Special Sampling;	
DATE AN	D TIME OF SAMPLING:, 1996 a.m./p.m. COLLECTED BY:TH\MV of	
DATIME	R:OR WATER DEPTH MEASUREMENT (Describe):	
MONITOR	RING WELL CONDITION:	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	[] LOCKED: [] UNLOCKED	
	WELL NUMBER (IS - IS NOT) APPARENT	
•	STEEL CASING CONDITION IS:	
	INNER PVC CASING CONDITION IS:	
	WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT	
	[] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR	
	[] MONITORING WELL REQUIRED REPAIR (describe):	
Charle off		
Check-off	EQUIDMENT CLEANED REFORE USE WITH	
Check-off	EQUIPMENT CLEANED BEFORE USE WITH	
Check-off	EQUIPMENT CLEANED BEFORE USE WITH	
1[]	Items Cleaned (List):	
Check-off 1 []	PRODUCT DEPTH	FT. BELOW DATUM
1[]	Items Cleaned (List):	FT. BELOW DATUM
1[]	PRODUCT DEPTH	FT. BELOW DATUM
1[]	PRODUCT DEPTH	FT. BELOW DATUM
1 [] 2 []	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with:	FT. BELOW DATUM
1[]	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe):	FT. BELOW DATUMFT. BELOW DATUM
1 [] 2 []	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance:	FT. BELOW DATUM
1 [] 2 []	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor:	FT. BELOW DATUM
1 [] 2 []	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance:	FT. BELOW DATUM
1[] 2[] 3[]	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor:	FT. BELOW DATUM
1 [] 2 []	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor: Other Comments: WELL EVACUATION: Method:	FT. BELOW DATUM
1[] 2[] 3[]	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor: Other Comments: WELL EVACUATION: Method: Volume Removed:	FT. BELOW DATUM
1[] 2[] 3[]	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor: Other Comments: WELL EVACUATION: Method: Volume Removed: Observations: Water (slightly - very) cloudy	FT. BELOW DATUM
1[] 2[] 3[]	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor: Other Comments: WELL EVACUATION: Method: Volume Removed: Observations: Water (slightly - very) cloudy Water level (rose - fell - no change)	FT. BELOW DATUM
1[] 2[] 3[]	Items Cleaned (List): PRODUCT DEPTH Measured with: WATER DEPTH Measured with: WATER-CONDITION BEFORE WELL EVACUATION (Describe): Appearance: Odor: Other Comments: WELL EVACUATION: Method: Volume Removed: Observations: Water (slightly - very) cloudy	FT. BELOW DATUM

FIGURE 3.6

GROUNDWATER SAMPLING RECORD

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SAMPLE	E EXTRACTION N		
	[] Pump, tyr)e:	
	[] Other, de	scribe:	
	Sample obtain	ed is [] GRAB; []	COMPOSITE SAMPLE
ON-SITE	E MEASUREMEN	TS:	
	Temp:		Measured with:
	pH:		Measured with:
			Measured with: Measured with:
			Measured with:
			Measured with:
			Measured with:
	Sulfate:		Measured with:
	Ferrous Iron:		Measured with:
	Other:		
SAMPLI	E CONTAINERS (material, number, size):
			•
ON-SITI	E SAMPLE TREA	IMENT:	
f I	Filtration:	Method	Containers:
f 1	i nuadon.		Containers:
		Method	
		. 4 4 . 4.	
[]	Preservatives	added:	
		Method	Containers:
		Method	
		Method	Containers:
		Method	Containers:
CONTA	INER HANDLING	} :	
001111			
		er Sides Labeled	
	[] Contair	ner Lids Taped	
	[] Contair		t
OTUED	[] Contair	ner Lids Taped ners Placed in Ice Ches	
OTHER	[] Contair	ner Lids Taped ners Placed in Ice Ches	t
OTHER	[] Contair	ner Lids Taped ners Placed in Ice Ches	
OTHER	[] Contair	ner Lids Taped ners Placed in Ice Ches	
OTHER	[] Contair	ner Lids Taped ners Placed in Ice Ches	
OTHER	[] Contair	ner Lids Taped ners Placed in Ice Ches	
OTHER	[] Contair	ner Lids Taped ners Placed in Ice Ches	
	SAMPLE ON-SITE	Sample obtain ON-SITE MEASUREMEN Temp: pH: Conductivity: Dissolved Oxy Redox Potenti: Salinity: Nitrate: Sulfate: Ferrous Iron: Other: ON-SITE SAMPLE TREA* [] Filtration:	Sample obtained is [] GRAB; [] ON-SITE MEASUREMENTS: Temp: o pH: Conductivity: Dissolved Oxygen: Redox Potential: Salinity: Nitrate: Sulfate: Ferrous Iron: Other: Other: ON-SITE SAMPLE TREATMENT: [] Filtration: Method Method Method Method [] Preservatives added: Method

GROUNDWATER SAMPLING RECORD

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total well depths will be thoroughly cleaned before and after field use and between uses at different sampling locations according to the procedures presented in Section 3.3.2.1. In addition to the use of properly cleaned equipment, dedicated HDPE tubing will be used at each sampling point, and a clean pair of new, disposable nitrile or latex gloves will be worn each time a different well or monitoring point is sampled. The following paragraphs present the procedures to be followed for groundwater sample collection from groundwater monitoring wells and monitoring points. These activities will be performed in the order presented below. Exceptions to this procedure will be noted in the sampler's field notebook and the groundwater sampling form.

3.3.3.1 Preparation of Location

Prior to starting the sampling procedure, the area around the existing wells and new monitoring points will be cleared of foreign materials, such as brush, rocks, and debris. These procedures will prevent sampling equipment from inadvertently contacting debris around the monitoring well/point.

3.3.3.2 Water Level and Total Depth Measurements

Prior to removing any water from the monitoring well or monitoring point, the static water level will be measured. An electric water level probe will be used to measure the depth to groundwater below the datum to the nearest 0.01 foot. After measuring the static water level, the water level probe will be slowly lowered to the bottom of the monitoring well/point, and the depth will be measured to the nearest 0.01 foot. Based on these measurements, the volume of water to be purged from the monitoring well/point will be calculated. If mobile LNAPL is encountered, the thickness of the LNAPL layer will be measured.

3.3.3.3 Purging Before Sampling

The volume of water contained within the monitoring well/monitoring point casing at the time of sampling will be calculated, and three times the calculated volume will be removed from the well/monitoring point. Clean and contaminated purge waters will be stored in 55-gallon drums or buckets. Water with a headspace reading less than 5 ppmv will be redistributed on the ground surface at the site. Water with headspace readings above 5 ppmv will be collected and transported to the on-Base landfarm for disposal

If a monitoring well/monitoring point is evacuated to a dry state during purging, the monitoring well/monitoring point will be allowed to recharge, and the sample will be collected as soon as sufficient water is present in the monitoring well or monitoring point to obtain the necessary sample quantity. Sample compositing or sampling over a lengthy period by accumulating small volumes of water at different times to obtain a sample of sufficient volume will not be allowed.

3.3.3.4 Sample Extraction

HDPE tubing and a peristaltic pump will be used to extract groundwater samples from the monitoring wells and well points. The tubing will be lowered through the well and 0.75-inch-outside diameter PVC monitoring point casing into the water gently to prevent splashing. The sample will be transferred directly into the appropriate sample container. The water will be carefully poured down the inner walls of the sample bottle to minimize aeration of the sample.

Unless other instructions are given by the analytical laboratory, sample containers will be completely filled so that no air space remains in the container. Excess water collected during sampling will be placed into 55-gallon drums used for monitoring well/monitoring point purge waters and transported for disposal by Base personnel to the on-Base facilities

3.3.4 Onsite Groundwater Parameter Measurement

As indicated on Table 3.1, many of the groundwater chemical parameters will be measured onsite by Parsons ES personnel. Some of the measurements will be made with direct-reading meters, while others will be made using of a Hach® portable colorimeter in accordance with specific Hach® analytical procedures. These procedures will be described in the following subsections.

All glassware or plasticware used in the analyses will have been cleaned prior to sample collection by thoroughly washing with a solution of Alconox® and water, and rinsing with deionized water and ethanol to prevent interference or cross contamination between measurements. If concentrations of an analyte are above the range detectable by the titrimetric method, the analysis will be repeated by diluting the groundwater sample with double-distilled water until the analyte concentration falls to a level within the range of the method. All rinseate and sample reagents accumulated during groundwater analysis will be collected in glass containers fitted with screw caps. These waste containers will be clearly labeled as to their contents and carefully stored for later transfer by Base personnel to the approved disposal facility.

3.3.4.1 Dissolved Oxygen (DO) Measurements

DO measurements will be made using a meter with a downhole oxygen sensor or a sensor in a flow-through cell. Measurements will be taken before and immediately following groundwater sample acquisition. When DO measurements are taken in monitoring wells/points that have not yet been sampled, the existing monitoring wells/points will be purged until DO levels stabilize. DO measurements will be recorded on the groundwater sampling record (Figure 3.6)

3.3.4.2 pH, Temperature, and Specific Conductance

Because the pH, temperature, and specific conductance of a groundwater sample can change significantly within a short time following sample acquisition, these parameters will be measured in the field in unfiltered, unpreserved, "fresh" water collected by the same technique as the samples taken for laboratory analyses. The measurements will be made in a clean glass container separate from those intended for laboratory analysis, and the measured values will be recorded in the groundwater sampling record (Figure 3.6).

3.3.4.3 Carbon Dioxide Measurements

Carbon dioxide (CO₂) concentrations in groundwater will be measured in the field by experienced Parsons ES scientists via titrimetric analysis using CHEMetrics Method 4500 (0 to 250 mg/L as CO₂). Sample preparation and disposal procedures are the same as outlined at the beginning of Section 3.3.4.

3.3.4.4 Alkalinity Measurements

Alkalinity in groundwater helps buffer the groundwater system against acids generated through both aerobic and anaerobic biodegradation processes. Alkalinity of the groundwater sample will be measured in the field by experienced Parsons ES scientists via titrimetric analysis using USEPA-approved Hach® Method 8221 (0 to 5,000 mg/L as calcium carbonate).

3.3.4.5 Nitrate- and Nitrite-Nitrogen Measurements

Nitrate-nitrogen concentrations are of interest because nitrate can act as an electron acceptor during hydrocarbon biodegradation under anaerobic soil or groundwater conditions. Nitrate-nitrogen is also a potential nitrogen source for hydrocarbon-degrading bacteria biomass formation. Nitrite-nitrogen is an intermediate byproduct in both ammonia nitrification and in nitrate reduction in anaerobic environments.

Nitrate- and nitrite-nitrogen concentrations in groundwater will be measured in the field by experienced Parsons ES scientists via colorimetric analysis using a Hach® DR/700 Portable Colorimeter. Nitrate concentrations in groundwater samples will be analyzed after preparation with Hach® Method 8039 (0 to 30.0 mg/L nitrate). Nitrite concentrations in groundwater samples will be analyzed after preparation with USEPA-approved Hach® Method 8507 (0 to 0.35 mg/L nitrite).

3.3.4.6 Sulfate and Sulfide Sulfur Measurements

Sulfate in groundwater is a potential electron acceptor for fuel-hydrocarbon biodegradation in anaerobic environments, and sulfide is resultant after sulfate reduction. The Parsons ES scientist will measure sulfate and sulfide concentrations via colorimetric analysis with a Hach[®] DR/700 Portable Colorimeter after appropriate sample preparation. EPA-approved Hach[®] Methods 8051 (0 to 70.0 mg/L sulfate) and 8131 (0.60 mg/L sulfide) will be used to prepare samples and analyze sulfate and sulfide concentrations, respectively.

3.3.4.7 Total Iron, Ferrous Iron, and Ferric Iron Measurements

Iron is an important trace nutrient for bacterial growth, and different states of iron can affect the oxidation/reduction potential of the groundwater and act as an electron acceptor for biological metabolism under anaerobic conditions. Iron concentrations will be

measured in the field via colorimetric analysis with a Hach[®] DR/700 Portable Colorimeter after appropriate sample preparation. Hach[®] Method 8008 for total soluble iron (0 to 3.0 mg/L ferric + ferrous iron) and Hach[®] Method 8146 for ferrous iron (0 to 3.0 mg/L) will be used to prepare and quantitate the samples. Ferric iron will be quantitated by subtracting ferrous iron levels from total iron levels.

3.3.4.8 Manganese Measurements

Manganese is a potential electron acceptor under anaerobic environments. Manganese concentrations will be quantitated in the field using colorimetric analysis with a Hach® DR/700 Portable Colorimeter. EPA-approved Hach® Method 8034 (0 to 20.0 mg/L) will be used to prepare the samples for quantitation of manganese concentrations. Sample preparation and disposal procedures are outlined earlier in Section 3.3.4.

3.3.4.9 Reduction/Oxidation Potential

The reduction/oxidation (redox) potential of groundwater is an indicator of the relative tendency of a solution to accept or transfer electrons. Redox reactions in groundwater are usually biologically mediated; therefore, the redox potential of a groundwater system depends upon and influences rates of biodegradation. Redox potential can be used to provide real time data on the location of the contaminant plume, especially in areas undergoing anaerobic biodegradation. The redox potential of a groundwater sample taken inside the contaminant plume should have a redox potential somewhat less than that taken in the upgradient location.

The redox potential of a groundwater sample can change significantly within a short time following sample acquisition and exposure to atmospheric oxygen. As a result, this parameter will be measured in the field in unfiltered, unpreserved, "fresh" water collected by the same technique as the samples taken for laboratory analyses. The measurements will be made as quickly as possible in a clean glass container separate from those intended for laboratory analysis.

3.3.5 Handling of Samples for Laboratory Analysis

This section describes the procedures for sample handling from the time of sampling until the samples arrive at the laboratory.

3.3.5.1 Sample Preservation

The analytical laboratory support personnel will add any necessary chemical preservatives prior to shipping the containers to the site. Samples will be prepared for transportation to the analytical laboratory by placing the samples in a cooler containing ice to maintain a shipping temperature of approximately 4 degrees centigrade (°C). Samples will be delivered to the analytical laboratory via overnight courier so that all sample holding times are met.

3.3.5.2 Sample Container and Labels

Sample containers and appropriate container lids will be provided by the analytical laboratory (see Appendix A). The sample containers will be filled as described in Section 3.3.3.2.4, and the container lids will be tightly closed. The sample label will be firmly attached to the container side, and the following information will be legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample type (e.g., groundwater);
- Sampling date;

- Sampling time;
- Preservatives added;
- Sample collector's initials; and
- Requested analyses.

3.3.5.3 Sample Shipment

After the samples are sealed and labeled, they will be packaged for transport to the mobile laboratory. The following packaging and labeling procedures will be followed:

- Package sample so that it will not leak, spill, or vaporize from its container;
 - Cushion samples to avoid breakage; and
 - Add ice to container to keep samples cool.

The packaged samples will be delivered by overnight courier to the analytical laboratory. Delivery will occur as soon as possible after sample acquisition.

3.3.5.4 Chain-of-Custody Control

After the samples have been collected, chain-of-custody procedures will be followed to establish a written record of sample handling and movement between the sampling site and the analytical laboratory. Each shipping container will have a chain-of-custody form completed in triplicate by the sampling personnel. One copy of this form will be kept by the sampling contractor after sample delivery to the analytical laboratory, and the other two copies will be retained at the laboratory. One of the laboratory copies will become a

part of the permanent record for the sample and will be returned with the sample analytical results. The chain-of-custody will contain the following information:

- Sample identification number;
- Sample collectors' printed names and signatures;
- Date and time of collection;
- Place and address of collection;
- Sample matrix;
- Chemical preservatives added;
- Analyses requested;
- Signatures of individuals involved in the chain of possession; and
- Inclusive dates of possession

The chain-of custody documentation will be placed inside the shipping container so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during transport. The shipping container will be sealed so that it will be obvious if the seal has been tampered with or broken.

3.3.5.5 Sampling Records

In order to provide complete documentation of the sampling event, detailed records will be maintained by the field scientist. At a minimum, these records will include the following information:

- Sample location (facility name);
- Sample identification;
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observations of
- Sample appearance, and
- Sample odor;
- Weather conditions;
- Water level prior to purging;
- Total monitoring well/monitoring point depth;
- Purge volume;
- Water level after purging;
- Monitoring well/point condition;
- Sampler's identification;
- Field measurements of pH, temperature, DO, and specific conductivity; and
 - Any other relevant information.

Groundwater sampling information will be recorded on a groundwater sampling form. Figure 3.6 shows an example of the groundwater sampling record.

3.3.6 Laboratory Analyses

Laboratory analyses will be performed on all groundwater samples and the QA/QC samples described in Section 5. The analytical methods for this sampling event are listed in Table 3.1. Prior to sampling, arrangements will be made with the analytical laboratory to provide a sufficient number of appropriate sample containers for the samples to be collected. All containers, preservatives, and shipping requirements will be consistent with USEPA protocol or those reported in Appendix A of this plan.

Analytical laboratory support personnel will specify the necessary QC samples and prepare appropriate QC sample bottles. For samples requiring chemical preservation, preservatives will be added to containers by the laboratory prior to delivery to the site. Containers, ice chests with adequate padding, and cooling media may be sent by the laboratory to the site. Sampling personnel will fill the sample containers and return the samples to the laboratory.

3.4 AQUIFER TESTING

Aquifer Slug tests will be conducted on selected existing wells to estimate the hydraulic conductivity of unconsolidated sand and clay deposits at the site. This information is required to accurately estimate the velocity of groundwater and contaminants in the shallow saturated zone. A slug test is a single-well hydraulic test used to determine the hydraulic conductivity of an aquifer in the immediate vicinity of the tested well. Slug tests can be used for both confined and unconfined aquifers that have a transmissivity of less than 7,000 square feet per day (ft²/day). Slug testing can be

performed using either a rising head or a falling head test; at this site, both methods will be used in sequence.

3.4.1 Definitions

- Hydraulic Conductivity (K). A quantitative measure of the ability of porous material to transmit water; defined as the volume of water that will flow through a unit cross-sectional area of porous or fractured material per unit time under a unit hydraulic gradient.
- Transmissivity (T). A quantitative measure of the ability of an aquifer to transmit water. It is the product of the hydraulic conductivity and the saturated thickness.
- Slug Test. Two types of testing are possible: rising head and falling head tests. A slug test consists of adding a slug of water or a solid cylinder of known volume to the well to be tested or removing a known volume of water or cylinder and measuring the rate of recovery of water level inside the well. The slug of a known volume acts to raise or lower the water level in the well.
- Rising Head Test. A test used in an individual well within the saturated zone to estimate the hydraulic conductivity of the surrounding formation by lowering the water level in the well and measuring the rate of recovery of the water level. The water level may be lowered by pumping, bailing, or removing a submerged slug from the well.
- Falling Head Test. A test used in an individual well to estimate the hydraulic conductivity of the surrounding formation by raising the water level in the well by insertion of a slug or quantity of water, and then measuring the rate of drop in the water level.

3.4.2 Equipment

The following equipment will be used to conduct a slug test:

- Teflon®, PVC, or metal slugs;
- Nylon or polypropylene rope;
- Electric water level indicator;
- Pressure transducer/sensor;
- Field logbook/forms; and
- Automatic data recording instrument (such as the Hermit Environmental Data Logger[®], In-Situ, Inc. Model SE1000B, or equivalent).

3.4.3 General Test Methods

Aquifer hydraulic conductivity tests (slug tests) are accomplished by either removal of a slug or quantity of water (rising head) or introduction of a slug (falling head), and then allowing the water level to stabilize while taking water level measurements at closely spaced time intervals.

Because hydraulic testing will be completed on existing wells, it will be assumed that the wells were properly developed and that water levels have stabilized. Slug testing will proceed only after multiple submerged pressure transducer measurements over time show that static water levels are in equilibrium. During the slug test, the water level change should be influenced only by the introduction (or removal) of the slug volume. Other factors, such as inadequate well development or extended pumping may lead to

inaccurate results; slug tests will not be performed on wells with free product. The field scientist will determine when static equilibrium has been reached in the well. The pressure transducer, slugs, and any other downhole equipment will be decontaminated prior to and immediately after the performance of each slug test using the procedures described in Section 3.3.2.1.

3.4.4 Falling Head Test

The falling head test is the first step in the two-step slug-testing procedure. The following steps describe procedures to be followed during performance of the falling head test.

- 1. Decontaminate all downhole equipment prior to initiating the test.
- Open the well. Where wells are equipped with water-tight caps, the well should be unsealed at least 24 hours prior to testing to allow the water level to stabilize.
 The protective casing will remain locked during this time to prevent vandalism.
- 3. Prepare the Aquifer Slug Test Data Form (Figure 3.7) with entries for:
 - Borehole/well number,
 - Project number,
 - Project name,
 - Aquifer testing team,
 - Climatic data,
 - Ground surface elevation,

Location Eaker AFB - BX Shoppette	Client AFCEE	Well No
Job No. 722450.15	Field Scientist MV\TH	Date
Water Level	Total Well	
Depth	-	
Measuring Datum	Elevation of Datum	
Weather	Temp	
Comments		

Beginning Time	Ending Time	Initial Head Reading	Ending Head Reading	Test Type (Rise/Fall)	File Name	Comments
		1				
					<u> </u>	
				<u> </u>		

FIGURE 3.7

AQUIFER TEST DATA FORM

BX Shoppette Intrinsic Remediation TS Eaker AFB, Arkansas

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

- Top of well casing elevation,
- Identification of measuring equipment being used,
- Page number,
- Static water level, and
- Date.
- 4. Measure the static water level in the well to the nearest 0.01 foot.
- 5. Lower the decontaminated pressure transducer into the well and allow the displaced water to return to its static level. This can be determined by periodic water level measurements until the static water level in the well is within 0.01 foot of the original static water level or the submerged pressure-transducer indicates no pressure changes (indicating equilibrium).
- 6. Lower the decontaminated slug into the well to just above the water level in the well.
- 7. Turn on the data logger and quickly lower the slug below the water table, being careful not to disturb the pressure transducer. Follow the owner's manual for proper operation of the data logger.
- 8. Terminate data recording when the water level stabilizes in the well. The well will be considered stabilized for termination purposes when it has recovered 80 to 90 percent from the initial slug.

3.4.5 Rising Head Test

After completion of the falling head test, the rising head test will be performed. The following steps describe the rising-head slug test procedure.

- 1. Measure the water level in the well to the nearest 0.01 foot to ensure that it has returned to the static water level.
- 2. Initiate data recording and quickly withdraw the slug from the well. Follow the owner's manual for proper operation of the data logger.
- 3. Terminate data recording when the water level stabilizes in the well, and remove the pressure transducer from the well and decontaminate. The well will be considered stabilized for termination purposes when it has recovered 80 to 90 percent from the initial slug.

3.4.6 Slug Test Data Analysis

Data obtained during slug testing will be analyzed using AQTESOLVTM and the method of Hvorslev (1951) for confined aquifers or the method of Bouwer and Rice (1976) and Bouwer (1989) for unconfined conditions.

SECTION 4

REMEDIAL OPTION EVALUATION AND TS REPORT

Upon completion of field work, numerical and analytical groundwater models will be used to determine the fate and transport of fuel hydrocarbons dissolved in groundwater at the site. Based upon model predictions of contaminant concentration and distribution through time, and upon potential receptor exposure pathways, the potential risk to human health and the environment will be assessed. If it is shown that intrinsic remediation of BTEX compounds at the sites is sufficient to reduce the potential risk to human health and the environment to acceptable levels, Parsons ES will recommend implementation of the intrinsic remediation option. If intrinsic remediation is chosen, Parsons ES will prepare site-specific, long-term monitoring plans that will specify the location of point-of-compliance monitoring wells and sampling frequencies.

If the intrinsic remediation remedial option is deemed inappropriate for use at this site, institutional controls such as groundwater or land use restrictions will be evaluated to determine if they will be sufficient to reduce the risk to human health and the environment to acceptable levels. If institutional controls are inappropriate, remedial options which could reduce risks to acceptable levels will be evaluated and the most appropriate remedial options will be recommended. Potential remedial options include, but are not limited to, mobile LNAPL recovery, groundwater pump-and-treat, enhanced biological treatment, bioventing, air sparging, and *in situ* reactive barrier walls. The

reduction in dissolved BTEX that should result from remedial activities will be used to produce new input files for the groundwater models. The models will then be used to predict the BTEX plume (and risk) reduction that should result from remedial actions.

Upon completion of modeling and remedial option selection, a TS report detailing the results of the modeling and remedial option selection will be prepared. This report will follow the outline presented in Table 4.1 and will contain an introduction, site description, identification of remediation objectives, description of remediation alternatives, an analysis of remediation alternatives, and the recommended remedial approach for the site. This report will also contain the results of the site characterization activities described herein and a description of the models developed for the site.

TABLE 4.1 EXAMPLE TS REPORT OUTLINE BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

INTRODUCTION

Scope and Objectives
Site Background

SITE CHARACTERIZATION ACTIVITIES

Sampling and Aquifer Testing Procedures

PHYSICAL CHARACTERISTICS OF THE STUDY AREA

Surface Features

Regional Geology and Hydrogeology

Site Geology and Hydrogeology

Climatological Characteristics

NATURE AND EXTENT OF CONTAMINATION

Source Characterization

Soil Chemistry

Residual Contamination

Total Organic Carbon

Ground Water Chemistry

LNAPL Contamination

Dissolved Contamination

Ground Water Geochemistry

Expressed Assimilative Capacity

GROUND WATER MODEL

Model Description

Conceptual Model Design and Assumptions

Initial Model Setup

Model Calibration

Sensitivity Analysis

Model Results

Conclusions

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Remedial Alternative Evaluation Criteria

Long-Term Effectiveness

Implementability (Technical, Administrative)

Cost (Capital, Operating, Present Worth)

Factors Influencing Alternatives Development

Program Objectives

Contaminant Properties

Site-Specific Conditions

Brief Description of Remedial Alternatives

Intrinsic Remediation with Long-Term Monitoring

Other Alternatives

Evaluation of Alternatives

Recommended Remedial Approach

TABLE 4.1 (Concluded) EXAMPLE TS REPORT OUTLINE BX SHOPPETTE INTRINSIC REMEDIATION TS EAKER AFB, ARKANSAS

LONG-TERM MONITORING PLAN

Overview Monitoring Networks Ground Water Sampling

CONCLUSIONS AND RECOMMENDATIONS

APPENDICES: Supporting Data and Documentation
Site-Specific Bioplume II Model Input and Results

SECTION 5

QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC procedures will include collection of field replicates and duplicates and rinseate, field and trip blanks; decontamination of all equipment that contacts the sample medium before and after each use; use of analyte-appropriate containers; and chain-of-custody procedures for sample handling and tracking. All samples to be transferred to the analytical laboratory for analysis will be clearly labeled to indicate sample number, location, matrix (e.g., groundwater), and analyses requested. Samples will be preserved in accordance with the analytical methods to be used, and water sample containers will be packaged in coolers with ice to maintain a temperature of as close to 4°C as possible.

All field sampling activities will be recorded in a bound, sequentially paginated field notebook in permanent ink. All sample collection entries will include the date, time, sample locations and numbers, notations of field observations, and the sampler's name and signature. Field QC samples will be collected in accordance with the program described below, and as summarized in Table 5.1.

QA/QC sampling will include collection and analysis of duplicate groundwater and replicate soil samples, rinseate blanks, field/trip blanks, and matrix spike samples. Internal laboratory QC analyses will involve the analysis of laboratory control samples (LCSs) and laboratory method blanks (LMBs). QA/QC objectives for each of these samples, blanks, and spikes are described below.

TABLE 5.1
QA/QC SAMPLING PROGRAM
BX SHOPPETTE
INTRINSIC REMEDIATION TS
EAKER AFB, ARKANSAS

Analytical Methods	VOCs, TPH	VOCs	VOCs	VOCs	VOCs	Laboratory Control Charts (Method Specific)	Laboratory Control Charts (Method Specific)
Collection/Analysis	3 Groundwater and 2 Soil Samples (10%)	1 Sample	1 Sample	One per shipping cooler containing VOC samples	Once per sampling event	Once per method per medium	Once per method per medium
QA/QC Sample Types	Duplicates/Replicates	Rinseate Blanks	Field Blanks	Trip Blanks	Matrix Spike Samples	Laboratory Control Sample	Laboratory Method Blanks

5-2

Only one rinseate sample will be collected at the site because dedicated tubing will eliminate the potential for cross-contamination due to improper decontamination of sampling tubing. Rinseate samples will consist of a sample of distilled water poured into or pulled through decontaminated or new sampling equipment and subsequently transferred into a sample container provided by the laboratory. Rinseate samples will be analyzed for VOCs only.

A field blank will be collected to assess the effects of ambient conditions in the field. The field blank will consist of a sample of distilled water poured into a laboratory-supplied sample container while sampling activities are underway. The field blank will be analyzed for VOCs.

A trip blank will be analyzed to assess the effects of ambient conditions on sampling results during the transportation of samples. The trip blank will be prepared by the laboratory. A trip blank will be transported inside each cooler which contains samples for VOC analysis. Trip blanks will be analyzed for VOCs.

Matrix spikes will be prepared in the laboratory and used to establish matrix effects for samples analyzed for VOCs. LCSs and LMBs also will be prepared internally by the laboratory and will be analyzed each day that samples from the site are analyzed. Samples will be reanalyzed in cases where the LCS or LMB are out of the control limits. Control charts for LCSs and LMBs will be developed by the laboratory and monitored for the analytical methods used.

SECTION 6

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APPENDIX A

CONTAINERS, PRESERVATIVES, PACKAGING, AND SHIPPING

REQUIREMENTS FOR GROUNDWATER SAMPLES

Field or Fixed-Base	Fixed-base		Fixed-base	Fixed-base	Field
Sample Volume, Sample Container,	Collect 100 g of soil in a glass container with Tefton-lined cap; cool to 4°C		Use a portion of soil sample collected for another analysis	Collect 250 g of soil in a glass or plastic container, preservation is unnecessary	NA
Recommended Frequency of	At initial sampling		Each soil sampling round	One time during life of project	Each sampling round
i i	Relatively high amounts of TOC may be indicative of a reducing environment and may indicate the need for analysis of electron acceptors associated with that environment; the rate of mieration of petroleum	contaminants in groundwater is dependent upon the amount of TOC in the saturated zone soil; the rate of release of petroleum contaminants from the source into groundwater is dependent (in part) on the amount of TOC in the	vadose zone soil Data are used to correct soil sample analytical results for moisture content (e.g., report results on a dry	weight cashs) Data are used to infer hydraulic conductivity of aquifer, and are used in calculating sorption of contaminants	Data used to understand the carbon dioxide concentration gradient with depth and to infer the biological degradation of
	Procedure must be accurate over the range of 0.5–15 percent TOC		Handbook method	Procedure provides a distribution of grain size by sieving	Soil gas carbon dioxide may be produced by the degradation of petroleum by the by the petroleum by the controls of the petroleum by the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the controls of the control of the controls of the controls of the controls of the control of the controls of the control of the c
	Swamples		ASTM D-2216	ASTM D422	Nondispersive infrared instrument operating over the range of approximately 0.1–15 percent
	Total organic carbon (TOC)		Moisture	Grain size distribution	Carbon dioxide content of soil gas
	Soil		Soil	Soil	Soil gas

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TABLE A.1 SAMPLE PACKAGING AND HANDLING REQUIREMENTS BX Shoppette

ediation TS	Arkansas
Reme	AFB,
Intrinsic	Eaker /

				!	Recommended Frequency of	Sample Volume, Sample Container,	Field or Fixed-Base
Matrix	Analysis	Method/Reference	Comments	Data Use	Analysis	Sample Preservation	Laboratory
Soil	Volatile organics	Gas chromatography/ mass spectrometry	Handbood method	Data is used to determine the extent of chlorinated	Each sampling round	Collect 100 g of soil in a glass container with	Fixed-base
		method SW8240.		solvent and aromatic hydrocarbon contamination.		Teflon@-lined cap; cool	
				contaminant mass present,			
				and the need for source removal			
Soil	Dehydrogenase	Colorimetric	Reduction of added	An indicator of the	At the beginning	Collect 100 g of soil in	Field
	enzyme activity	RSKSOP-100	triphenyltetrazolium	presence of soil microbes,	of the project	a glass container	
	(optional)		migrobes is	William necessary to			
			measured				
			colorimetrically;				
			analyze				
Soil	Aromatic	Purge and trap gas	Handbook method	Data is used to determine	Each sampling	Collect 100 g of soil in	Fixed-base
	hydrocarbons	chromatography (GC)	modified for field	the extent of soil	round	a glass container with	
	(benzene,	method SW8020	extraction of soil	contamination, the		Teflon-lined cap; cool	
	toluene, ethyl-		using methanol	contaminant mass present,		to 4°C	
	benzene, and			and the need for source			
	xylene [B1EX];			removai			
	isomers)					:	:
Soil	Total	GC method SW8015	Handbook method,	Data are used to determine	Each sampling	Collect 100 g of soil in	Fixed-base
	hydrocarbons,	[modified]	reference is the	the extent of soil	punos	a glass container with	
4	volatile and		California LUF1	contamination, the		l ellon-lined cap; cool	
	extractable		manual	contaminant mass present.		, to 4.°C	
:				and the need for source			

Field or Fixed-Base Laboratory	Field	Field	Field
Sample Volume, Sample Container, Sample Preservation	N/A	MA	N/A Collect 100 mL of water in a glass container, acidify with hydrochloric acid per method
Recommended Frequency of Analysis	Each sampling round	Each sampling round	Each sampling round Each sampling round
Data Use	Data are used to understand the oxygen concentration gradient with depth and to determine the presence or absence of aerobic degradation processes	Soil gas methane can be used to locate confaminated soil and to determine the presence of anacrobic processes, see discussion of data use for methane in water	Data used to understand the petroleum hydrocarbon concentration gradient with depth and to locate the most heavily contaminated soils May indicate an anaerobic degradation process due to degradation of oxygen, nifrate, and manganese
Comments	The concentration of soil gas oxygen is often related to the amount of biological activity, such as the degradation of petroleum hydrocarbons; soil gas oxygen concentrations may decrease to the point where anaerobic pathways dominate	Methane is a product of the anaerobic degradation of petroleum hydrocarbons	Soil gas hydrocarbons indicate the presence of these contaminants in the soil column Field only
Method/Reference	Electrochemical oxygen meter operating over the range of 0-25 percent of oxygen in the soil gas sample	Total combustible hydrocarbon meter using a platinum catalyst with a carbon trap, and operating in the low parts per million volume (ppmv)	Total combustible hydrocarbon meter operating over a wide ppmv range Colorimetric A3500-Fe D
Analysis	Oxygen content of soil gas	Methane content of soil gas	Fuel hydrocarbon vapor content of soil gas Ferrous (Fe*?)
Matrix	Soil gas	Soil gas	Soil gas Water

					Docommonded	Comple Volume	Field or
					Frequency of	Sample Container,	Fixed-Base
Matrix	Analysis	Method/Reference	Comments	Data Use	Analysis	Sample Preservation	Laboratory
Water	Ferrous (Fe ⁺²)	Colorimetric	Alternate method;	Same as above	Each sampling	Collect 100 mL of	Field
		HACH Method # 8146	field only		round	water in a glass	
Water	Total Iron	Colorimetric	Field only		Each sampling	Collect 100mL of water	Field
		HACH Method # 8008	,		round	in a glass conatainer	
Water	Manganese	Colorimetric	Field only		Each sampling	Colect 100 mL of water	Field
)	HACH Method # 8034			round	in a glass conatiner	
Water	Chloride	Mercuric nitrate	Ion chromatography	General water quality	Each sampling	Collect 250 mL of	Field
		titration A4500-CI ⁻ C	(IC) method E300	parameter used as a marker	round	water in a glass	
The state of			or method SW9050	to verify that site samples		container	
\$			may also be used	are obtained from the same			
				groundwater system	;		
Water	Chloride	HACH Chloride test kit	Silver nitrate	Same as above	Each sampling	Collect 100mL of water	Field
		model 8-P	titration		round	in a glass container	The second second
Water	Oxygen	Dissolved oxygen meter	Refer to	The oxygen concentration	Each sampling	Collect 300 mL of	Field
			method A4500	is a data input to the	round	water in biochemical	
			for a comparable	Bioplume model;		oxygen demand bottles;	
			laboratory	concentrations less than		analyze immediately,	
A STATE OF			procedure	1 mg/L generally indicate		alternately, measure	
				an anaerobic pathway		dissolved oxygen in situ	
Water	Conductivity	E120.1/SW9050, direct	Protocols/Handbook	General water quality	Each sampling	Collect 100-250 mL of	Field
		reading meter	methods	parameter used as a marker	round	water in a glass or	
				to verify that site samples		plastic container	
				are obtained from the same			
		TYA OTT A 11-12-14-14-14	The state of the s	groundwater system	Took complime	Caller 100ml of unior	E.eld
Water	Aikaimity	Frit model AT AP MG-I.	method	parameter used (1) as a	round	in glass container	
				marker to verify that all			
				site samples are obtained			
				from the same groundwater			
9 A				system and (2) to measure			
				the buffering capacity of			
				groundwater			

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	:			**********			
Field or Fixed-Base Laboratory	Field	Fixed-base	Field	Field	Fixed-base	Field	Field
Sample Volume, Sample Container, Sample Preservation	Collect 250 mL of water in a glass or plastic container; analyze within 6 hours	Collect up to 40 mL of water in a glass or plastic container, cool to 4°C, analyze within 48 hours	Collect 100mL of water in a glass container	Collect 100mL of water in a glass container	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C	Collect up to 40 mL of water in a glass or plastic container, cool to 4°C	Collect 100 mL of water in a glass container, analyze immediately
Recommended Frequency of Analysis	Each sampling round	Each sampling round	Each sampling round	Each sampling round	Each sampling round	Each sampling round	Each sampling round
Data Use	Same as above	Substrate for microbial respiration if oxygen is depleted	Same as above	Substrate for microbial respiration if oxygen is depleted	Substrate for anaerobic microbial respiration	Same as above	Product of sulfate-based anaerobic microbial respiration; analyze in conjunction with sulfate analysis
Comments	Handbook method	Method E300 is a Handbook method, method SW9056 is an equivalent procedure	Colorimetric	Colorimetric	Method E300 is a Handbook method; method SW9056 is an equivalent procedure	Colorimetric	Colorimetric
Method/Reference	A2320, titrimetric, E310.2, colorimetric	IC method E300 or method SW9056; colorimetric, method E353.2	HACH method # 8039 for high range method # 8192 for low range	HACH method #8040	IC method E300 or method SW9056	HACH method # 8051	HACH method # 8131
Analysis	Alkalinity	Nitrate (NO ₃ -1)	Nitrate (NO3 -¹)	Nitrite (NO	Sulfate (SO ₄ ²)	Sulfate (SO ₄ ²)	Dissolved sulfide (S ⁻²)
Matrix	Water	Water	Water	Water	Water	Water	Water

	ıse	ý												ŗ	30		. 2		-			À				or.		
Field or	Fixed-Base	Laboratory												Field													T.	
	<u> </u>													YY N													340 (134 (184	
me,	ainer,	Sample Preservation												or of	SS				- 5 5 - 5 5 - 5 5					180) 100 100 100 100 100 100 100 100 100 1				
Sample Volume,	Sample Container,	le Pres												Collect 100 mL of	water in a glass	ner												
Samp	Samp	Samp												Collec	water	container	. A.											
nded	cy of	is												ling													11 11 11 (1987)	
Recommended	Frequency of	Analysis												Each sampling	pu	61663) (4064) (4064)					5000 9600 9600 9600							
Re	프						_		_						-												1.79	
			ıre			rbons	under anaerobic conditions.	se	chemicals may indicate that	on is				The presence of free carbon		kely	onate	water,	carbon	suo	l with	mine	evated;	ions of	P		erial	oleum
		Data Use	thene s	he bio-	Jo uo	nydroca	bic cor	e of the	ay indi	gradati				e of free	olved in	is unli	ne carb	stem of	ed, the	entration	mparec	to deter	y are el	centrat	de con	erobic	for bact	of petro
		Dai	Ethane and ethene are	products of the bio-	transformation of	chlorinated hydrocarbons	r anaer	The presence of these	iicals m	anaerobic degradation is	occurring	0		presenc	dioxide dissolved in	groundwater is unlikely	because of the carbonate	buffering system of water,	but if detected, the carbon	dioxide concentrations	should be compared with	background to determine	whether they are elevated;	elevated concentrations of	carbon dioxide could	indicate an aerobic	mechanism for bacterial	degradation of petroleum
			Etha	prod	trans	chlor	nude	The	chem	anae	occm			The	diox	groun	peca	buffe	but i	diox	shou	back	whet	eleva	carbo	indic	meci	degr
		ts	hene	=	other	if		are					-		pot													
		Comments	Ethane and ethene	are analyzed in	addition to the other	analytes only if	nated	hydrocarbons are	contaminants	suspected of	oing	ical	transformation	Titrimetric;	alternate method							rijeri 1903 V						
		Ö	Ethane	are and	additic	analyto	chlorinated	hydroc	contan	suspec	undergoing	biological	transfe	Titrim	alterna				.(a) (3)					s (2)	eriji Vije			-13
		nce	ıt'd)											del	trics						76) 							6 %
		Refere	14 (cor											kit mo	:HEMe	00	1											
		Method/Reference	RSKSOP-114 (cont'd											HACH test kit model	23 or C	Method 4500		Regg out					AT YHO					- 21
_		Σ	RSK													Met	15 m	s i									4 	
		sis.	hene											oxide				2									3,	
		Analysis	Ethane, ethene											rbon die		3,											Y	
_			Eth											Ca	. 21						14	AVE.		idi S		X		-
		Matrix	Water											Water Carbon dioxide			,											
			ı>											-														

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
	Aromatic hydrocarbons (BTEX, trimethylbenzene isomers)	Purge and trap GC method SW8020	Handbook method; analysis may be extended to higher molecular weight alkyl benzenes	Method of analysis for BTEX, which is the primary target analyte for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance, method can be extended to higher molecular weight alkyl benzenes; trimethylbenzenes are used to monitor plume dilution if degradation is primarily anaerobic	Each sampling round	Collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
	Total hydrocarbons, volatile and extractable	GC method SW8015 [modified]	Handbook method; reference is the California LUFT manual	Data used to monitor the reduction in concentrations of total fuel hydrocarbons (in addition to BTEX) due to natural attenuation; data also used to infer presence of an emulsion or surface layer of petroleum in water sample, as a result of sampling	One time per year or as required by regulations	Volatile hydrocarbons—collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2 Extractable hydrocarbons—collect 1 L of water in a glass container; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
	Polycyclic aromatic hydrocarbons (PAHs) (optional)	GC/mass spectroscopy method SW8270; high-performance liquid chromatography method SW8310	Analysis needed only for several samples per site	PAHs are components of fuel and are typically analyzed for regulatory compliance, data on their concentrations are not used currently in the evaluation of natural attenuation	At initial sampling and at site closure or as required by regulations	Collect 1 L of water in a glass container; cool to 4°C	Fixed-base

Field or Fixed-Base Laboratory	Fixed-base		Fixed-base	Field
Sample Volume, Sample Container, Sample Preservation	Collect 40 mL of water in glass vials with Tefton-lined caps; add sulfuric acid to pH 2; cool to 4°C.	in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH 2	Collect 100 mL of water in an amber glass container with Teflonlined cap; preserve with sulfuric acid to pH less than 2; cool to 4°C	Collect 100–250 mL of water in a glass or plastic container, analyze immediately
Recommended Frequency of Analysis	At initial sampling and at site closure site closure	round	Each sampling round	Each sampling round
Data Use	Data used to monitor the reduction in concentrations of total fuel hydrocarbons (in addition to BTEX) due to natural attenuation.	chlorinated solvents and aromatic hydrocarbons for evaluation of cometabolic degradation; measured for regulatory compliance when chlorinated solvents are known site contaminants	An indirect index of microbial activity	Aerobic and anaerobic processes are pH-sensitive
Comments	A substitute method for measuring total volatile hydrocarbons; reports amount of fuel as carbon present in the sample; method available from the U.S. EPA Robert S. Kerr Laboratory		An oxidation procedure whereby carbon dioxide formed from DOC is measured by an infrared spectrometer. The minimum detectable amount of DOC is 0.05 mg/L	Protocols/Handbook methods
Method/Reference	Purge and trap GC method SW8020 modified to measure all volatile aromatic hydrocarbons present in the sample	SW8240	A5310 C	E150.1/SW9040, direct reading meter
Analysis	25 285 mm and many 1 A.S. 1 19 (2)	Volatine Organics	Dissolved organic carbon (DOC) (optional)	hН
Matrix	Water	Waler	Water	Water

PA.D

					Recommended Sample Volume,	Sample Volume,	Field or
					Frequency of	Sample Container,	Fixed-Base
Matrix	Analysis	Method/Reference	Comments	Data Use	Analysis	Sample Preservation	Laboratory
Water	Temperature	E170:1	Field only	Well development	Each sampling round	N/A	Field
Water	Redox potential	A2580 B	Measurements	The redox potential of	Each sampling	Collect 100-250 mL of	Field
	•		are made with	groundwater influences and	round	water in a glass	
			electrodes; results	is influenced by the nature	-)	container, filling	
	7		are displayed on a	of the biologically		container from bottom;	
			meter, samples	mediated degradation of		analyze immediately	
			should be protected	contaminants; the redox			
			from exposure to	potential of groundwater			
			atmospheric oxygen	may range from more			
				than 200 mV to less			
				than 400 mV			

- 1. "HACH" refers to the HACH Company catalog, 1990.
- Water and Wastewater, Standard Methods for the Examination of 1992. to 18th edition, refers .
- U.S. Environmental to Methods for Chemical Analysis of Water and Wastes, Protection Agency, March 1979. "E" refers . m
- "Protocols" refers to the AFCEE Environmental Chemistry Function Installation Restoration Program Analytical Protocols, 11 June 1992 4.
- "Handbook" refers to the AFCEE Handbook to Support the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS), September 1993. . 2
- "SW" refers to the *Test Methods for Evaluating Solid Waste, Physical, and Chemical Methods*, SW-846, U.S. Environmental Protection Agency, 3rd edition, 1986. . 9
- "ASTM" refers to the American Society for Testing and Materials, current edition. 7
- "RSKSOP" refers to Robert S. Kerr (Environmental Protection Agency Laboratory) Standard Operating Procedure. . ထ
- "LUFT" refers to the state of California Leaking Underground Fuel Tank Field Manual 1988 edition. . ი
- "Dissolved Oxygen and Methane in Water by a Gas Chromatography Headspace Equilibration Technique," by D. H. Kampbell, J. T. Wilson, and S. A. Vandegrift. International Journal of Environmental Analytical Chemistry, Volume 36, pp. 249-257, 10.

APPENDIX B ADDITIONAL SITE DATA

APPENDIX B - 1A

SOIL BOREHOLE LOGS

BX SHOPPETTE

Source: Halliburton NUS 1992, 1994, and 1995.



PLAN		<u>) L</u>	Sr	G (B	<u>Ol</u>	<u> </u>	<u>IG</u>	SHEET OF PROJECT 3K98 BORING NO. EAKER BH TWILD! JOB NO. 3K98 LOGGED BY: 153
	<			TANK PIT				رت	PeAp	PROJ. MGR. GVG EDITED BY: BFN DRILLING COMPANY: A.W POOL DRILLING TYPE: MOBILE B-61 DRILLING METHOD: HOLLOW STEM ANGER DRILLERS NAME: VINCE BARAZZA
Br	1 '	(بزريمني	,	F-1	150 1	1 2110 2111	ļ . 1			TOTAL DEPTH (FT.) 30' TIME STARTED 0735 DATE 12 11 91 TIME COMPLETED 0827 DATE 12 11 11
SAMPLER	DRIVEN	RECOVERED	TON	FIELD LABORATORY SAMPLE NUMBER	FIXED LABORATORY SAMPLE NUMBER	HNU SCAN (PPM)	CODE	DEPTH (FEET)		GROUND-WATER CONDITION AT COMPLETION OF DRILLING CROWNDWATER AT 19 ON CORE BACKET BACKFILLED, SEE WELL DATE TIME WEATHER CONDITIONS CLEAL, COOL, YOO SURFACE ELEVATION
tons. stut stoon 0-2	2		7 ency 6 crop	ĺ	} ·	0 0	CL	,	-74 -71	COMMENTS LIPACY AT SURFACE SITTY CLAY DK BROWN MOIST ABUNDAT DREANICS; TE SAND
ירב! 1-7'	5	7.5	1721R	E1101-1 (0745)	(re).	2	ŞW	3 4 5		SAND: MED GRAINED, WELL SCREED, BRDW. RUST COLORED, IRON-STAINING VERLY EVIDENT 2-6.5 MOIST CLAY; VERY MOIST PLASTIC, SOFT GROY-NX GROY: MINOR SILT 6-5-30.0'
72		Estate I			- 6	80				CLAY AS ABOVE; FUEL COOR
Spur 5000	5	5	באכשרטת.	E-101-2	1356 1214 (9	70	CL	9	1,1,1,	

FI			LC		0	Fil	Ī	RI	N	G (CONT'D.) SHEET OF PROJECT BORING NO.
SAMPLER	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO	FIXED LAB	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)		JOB NO. 3K98 TW1101
						50		//	- '	
SPOCA	5	5	באכישוניישאב	E1101-3	080-5	4 2 5	CT CT	/ 3 / 4 / 5 / 6	1 , 1 , 1 , 1	PUST- LT GROVE: MINER SILT PUST- LT GROVE: MOTTLED, TRACE MINOR DEGANICS. (WOOD FRAGS) OR OXIDE SLIGHT FUEL COOK
SPOON	5	5	Trans JX3	h-1011 A	2,80	0	C.L.	18 19 20 -21		CLAY AS ABOVE; Driller will put on solid auger and
57521647 Aucens, 22-30,	1		1	1		(23 14 15 26 27 28 19		DRILLER PEPOLTS DRILLING CLAY TO 30' TO REPLETED @ 0827
	TES:				JAN.			3 4 5 6 7		



F	FIE)		G	OF	: E	Ю	RII	NG	SHEET 1 OF 2
5	PLAI										PROJECT EAKER BORING NO.
İ			S T	MID	1				•		3K98 BX TW1102
											JOB NO. 3K98 LOGGED BY: JSB
						•					PROJ. MGR. GVG EDITED BY: BEN
											DRILLING COMPANY: AW POOL
		f	TANK	ļ				1	W1107		DRILL RIG TYPE: MOBILE B-61
		(ALEA) '					_		DRILLING METHOD: However Stom Buses
	1							\mathcal{J}	(9)	.]	DRILLERS NAME: V. BARAZZA .
	K	,									TOTAL DEPTH (FT.) 30
	E						/)	TIME STARTED 0945 DATE (2/11/9)
l		T	w.10	<u>(</u> 6)							COMPLETED 1238 DATE 12/1/19/
: 					ORY R	FR					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Saturated 2016, 7.5' and 18'
					RAT	RAT					
	~		RED	N C	82 82	083 ≥	z	2190			BACKFILLED DATE _ SEE COMPLETION FOR WEATHER CONDITIONS
	LER	Z E	ĮŲ.		LE A	EL P	SCA	Ö	ΞF		CLEAR, 50°, SLIBREEZE
ė	AME	EE		MO	FIEL D SAMPL	FIXED	P P P	COD	P = 1		SURFACE
	S-	تم	r.c	ဖြင့်	FR	டம	II	70	19=	治	COMMENTS ASPHALT AS SURFACE
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STRAIGH	12.00 L	7	0	{	١	1) !		H/	٥	5:11: 51 11 5 1 5
32	40								H	FM	moist of some small scavel clusts
_						<u> </u>			12	-3	moist of some small state troop
L							5		H	- 1	Clay brown, moist meeting stiff
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V			·	-	ú	N		CL	Ħ	ر - ا	Sand
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0	Special	1		1 7	-	9				1,-	
いっとしている	90	C	\Box		12	4			75	1.	
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S				4	4		6			- 1-	
. Paş		-	-								<u> </u>
			1	1		-	+,	57			SAND STRINGER by 7-7.5'; SATURATED
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	2000	s _		1	22-2 (11	, B			H.	,]	-
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	2 4		1 し	4	20		7	101	Ц_	1	PLASTIC SOME SILT. MOTTLED W
	3	1			1 - 1		1	Γ"	\sqcup_{n}	آ ار	RESDISH - GRAY MOTTLES.
					H	4					· · · · · · · · · · · · · · · · · · ·

	FI	EL	D	L) <u>G</u>	0	F	BC	RI	N(G (CONT'D.) SHEET 2 OF 2
	SAMPLER TYPE		RED		LAB. E NO.		AN	OLOGIC	OEPTH (FEET)		PROJECT EAKER BX BORING NO. JOB NO. 3K98 TW1102
							11		1/		CLAY AS ABOVE
Gar Spur	5800J	5	5	Ex Cerueni	}		7	Сн	12 13 14 15 16	1-1-1-1	PLAY AS ABOVE: MED. STIFF - STIFF PLASTIC. DEER BROWN THAN ABOVE BARREL WET AT 18'
CONT SPLIT	SP000	5	5	exenent	(81) E-20113	72010	0 4 5 5	ભ	18 19 20 21		CLAY AS ABOVE; SOFT-MED STIFF - STIFF AT BOTTOM; SOME SILT; MOTTLED BROWN-GITY RED BROWN DRILLER WILL INSURT CENTERS BIT TO FINISH HALE -
ST416#T	Autor 22 - 30	1	1	•	-	1			3 4 5 6 7 8		PINISIT ITELE 2
									30 1 2 3 4 5 6		TD:30
- E	NOT								9		



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•	PLAI										PROJECT BORING NO.
ĺ									٠-	-	BAKER BX TW1103
İ			120A	<u>~</u>						-	JOB NO. 3K98 LOGGED BY: 158
	••						•				PROJ. MGR. GVG EDITED BY: BFN
		*******			_						DRILLING COMPANY: AWPOOL
		(DRILL RIG TYPE: MOBILE B-61
											DRILLING METHOD: HOLLOW STEM ALGOR
									Twice3		DRILLERS NAME: V. BARRAZA
					C	440 E	Y		<u>ල</u>	۵	TOTAL DEPTH (FT.) 30
	7	١								PAP	TIME 1240 DATE 12/11/41
	~	-									TIME COMPLETED (335 DATE 12/11/91
i					ORY R	RY R					GROUND-WATER CONDITION AT COMPLETION OF DRILLING
					MBE	MBE					BACKFILLED. DATE 1/8/6-
	~	9	띪	Z	NON NON NON NON	83	Z	0190			BACKFILLED, 21330 DATE 1/8/52-
	LER	. Z	Ę.	SAMPLE			HNU SCAN (PPM)	LITHOLOGIC CODE	EF		WARM GOL SUNNY, LT BEEEZE
	YPE	E E		AND	FIELD I SAMPL	AZE A	Sq	CODE CODE	DEPT (FEE		SURFACE
	S-	اعت	F. C.	တပ	E W	டல	I	70		**	COMMENTS
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	Raich	2-	0	,		1	1		H/		
	STRAIGLH AUCHDE	٥		,	·				H		CLAY GREY-BROWN, SOME SILT TR SD,
	8					0			2		MOTTLED, MOIST STIFF; PREDUCT ODER
	: :				20	(3,	520				0.5 - 4.5
	į.,				r.	4		CL	3	(]	SD (± 5') MED-FINE GRAINED WELL SOIL
					0		50				WISOME GRAVEL CREY 4.5-7
	956				(3,)	TW1103			7		
	3 %					1 2	50		77	1	
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	Soco	4.				_ <u></u> <u></u> <u></u>	&			<u>'. '</u>	
		-	-		30	12.00	300	5 F			CLAY AS ABOVE, GREY-BROW W/ OXIDE
			K. Ber)(w) 30	<u> </u> _0	١.				POSICUES MOTTUED : STIFF MEDISTR
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	South			D	1	3	M.		H	-	Taising, pance sici
	1 3	47	1	G005	3.2	1 1	19		19	F =	
	1200			10	0 2	- 54	(,01)		H-		
	$12 \mathrm{v}$	'	1	1	1 ~	1 =	1 ~		11.		

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	SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO		HNUSCAN (PPM)	L/THOLOGIC CODE	DEPTH (FEET)		PROJECT BORING NO. JOB NO. 3K98 TW103
							200	12/11/6)	1 1 1	
Const Spelt	560013 12-17	5	5	9005	E1103-3@1311	Heom 14"	10	CL/CH	- 14 - 15 - 16	- -	CLAI AS ABOVE; BELOMES STIFFER AND MOTTUNE IS MURE APPARENT
CONTHUOUS	SPLIT SPUSI)	5	5	encencent	E1103-46 1818	(20:)	2 , ,	CL	18 19 20		CLAY AS ABOVE; GREY BELOW 17' NO MOTTLING MOTTLING MOTTLING MOTTLING CHAY IS SOST AT BOSTOM 21-22'
ONTINUOLIS	SPUT SPON	5	5	excerent	158 12/11/41 E1103-	E11-54-TW1103C	0 0 0 0	CL CH	23 24 25 26		CLAY; AS ASSIVE . TR SILT BLUE - GREY WINDTILING; DX GREY BELOW 26.
STRAIGHT	27-30	1		1		1	1		28 29 30		TD = 30'
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			GRA					V'	1	EAKER BX TW1104
	.02		614	(§)	TW	111 O	1		j	JOB NO. 3K98 LOGGED BY: 15B
7W	1102			<u> </u>					┪.	PROJ. MGR. GV G EDITED BY: BFN
_@										DRILLING COMPANY: AW POOL
									170	DRILL RIG TYPE: MUBILE 13-61
									17	DRILLING METHOD: HOLLOW-STEM AUGER
							Tω	1104)	DRILLERS NAME: V. BARRAZA .
			٠.			1		໑ ່		TOTAL DEPTH (FT.) 30
			221	STI	00					TIME 12 11 21 MEE -158 (439) V
		· · · · · · · · · · · · · · · · · · ·				1			-	COMPLETED 1500 DATE 12 11/51
1				≿	RY					GROUND-WATER CONDITION AT
				AE COR	ATORY Ber					COMPLETION OF DRILLING SATURATED ZONE 18.5 and 1 19'
		0		ORA	UME		<u> </u>			BACKFILLED. DATE (SEE COMPLETION
ER	7	ERED	m _S	EN	FRE	CAN	LITHOLOGIC CODE			WEATHER CONDITIONS TOLM
. اجرا	L S	⊢ò	40	مق	민수	PPM S	로버	F H		CLEAR, WARM 600
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STRAIGH AUGER	1	'	((GC	[]′	:	FILL TO 2' GRAVERLY CLAY
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3	1					0		Ц		
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-1					1			Ц		MED. STIFF PLASTIC : TR SILT +
בֻ						5	104	4		SD
۲ .			1 /		li		CH	Ц		2-8 CLAY
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7			12	3	1	8	60	В	-	CLAY; BROWN; VERY MOIST; MED. STIF
ונ	2 ر	1	77	1	145	1	5c/	H	-	PLASTIC; TR SILT + SD; NOTHED
31 6	- L	1 1			I		1	11	-	THE LANGUAGE LAND OUST LOUNED.
34 -		一つ	Cer	10	β1 '	6		H9		(LEENISH- GREY TO RUST CONCIED;
Co or Trough		>	EKCELLENT	F1104	છ ે	6				501 20NE 8-8.5'

*	SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.		LITHOLOGIC	DEPTH (FEET)	PROJECT EAKER BX JOB NO. 3K98	BORING NO. TWILO4
			正是	නිරි	FIS	正改	8	728	1//	 F.5 - 12 CAY AS ABO	η√ ἐ¯
with mucus	12-17	5	5	Ekcelent	!		4 5	CL CH	13		E; SILTY CLAY WINE
	26-17 Seos	5	5	EKCELLENT	E1104-2 (20)	6051 m	2 3 2	SC	18	CLAY AS AGO 18'; SAYE 20-21.5' SATURATED AT	
		No No	B ARI	26 ^t	CAN	from			23 24 25 26		
									26 29 30	TD = 30	
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		-		TWIL		. (/3	/ ˈɔ	1			- 11	JOB NO. 3K98 LOGGED BY: BFIN
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				CA	0 D	.	1	Ä		٠	11	DRILLING COMPANY: POO!
				CAZOR	404	1	1	ALES				DRILL RIG TYPE: mdile \$61
				¦ ý ř	L L L L L L L L L L L L L L L L L L L	Ì	\					DRILLING METHOD: Hellarston Accers
			٠.	1	- E'S	1_	L			:	- 11	DRILLERS NAME: V. Bastozza
				•	•.	•						TOTAL DEPTH (FT.) 25
											H	STARTED 0725 DATE 12/13/9/
												TIME COMPLETED 0803 DATE 12/13/91
		Ī			~	ER				Ī		ICONINIO-WATER CONDITION AL
					ATO HE	ATO BER				1	Ì	COMPLETION OF DRILLING
			۵					2		Ì		BACKFILLED, DATE - (SEE COMPLETION FOR
	Œ		ERE	NO NO	A A	FIXED LABOR SAMPLE NUM	HNU SCAN (PPM)	LITHOLOGIC CODE				WEATHER CONDITIONS Cloudy, coal & 48 of
	AMPLER	EN-	-8	70	ᅙᄛ	므로	ĭ Œ	로	Et	<u> </u>		Cloudy, Cool
	SAN	HE	FEE	SAN	FIEL	N S S S S S S S S S S S S S S S S S S S	型			4		SURFACE ELEVATION
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									$\prod_{m{z}}$. :	:	fines 0.2 tolog
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		İ						3] 3		•	Fill: Sand : median to Course
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	\$1 50/17	5.0	1	ام	37				Ц			Sandy Clay Clayer Ford: 500x15
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SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.		HNUSCAN PPM)	LITHOLOGIC	DEPTH FEET)		PROJECT EAKER PFR JOB NO. 3K98 EIITHOS
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5, 54,7 84152	5.0		Kerk	1	1	>540 >540	344	3 4 15 6	\	Serviced at m15' contract from 12:17' same as above Sord: sray, medium stained, moist tenet, losse,
	40	and a	Bred.	17 4 3	5'		SC	8 9 20 1 2		Sandy Clay; brown, moist, median et: fs, to soft, moderathy plastic mottled.
								2.5 6 7		T0:25'
								9 0 1 2 3		
شورند.	. 1							5 6 7		
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						,	. }	Ø			PROJ. MGR. GV G EDITED BY:			
				1	·	_		1	D.		DRILLING COMPANY: POOL			
					I	(D) Tw	8011	1	ROAD		DRILL RIG TYPE: mole/c , 1861			
								!			DRILLING METHOD: Hellow ten faces			
				™ €13	NAN (9 1105	,-	EUT	2000 MDG		DRILLERS NAME: y Buirozza			
		۲.							11	l	TOTAL DEPTH (FT.) 25			
				GRA	SS J1	اهادن					TIME STARTED 0936 DATE 12/12/9/			
ĺ					,			1		Ì	TIME			
=	_										GROUND-WATER CONDITION AT			
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			a	7		BON		ပ္			BACKFILLED. DATE SEE COMPLETION FORM			
9			ERED	NO.	-	PA	CAN	70010			WEATHER CONDITIONS			
1	است	一回	FEET	필	ದ್ದ	으로	HNU S((PPM)	3	EPTH		Partly classy, lite breeze, cool			
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1	Ž,					1	0		H	1-	1.11, 1.10			
	P								H5	1.1	Sand most, medicastill			
	113							ML	H		alsone exide a dules, storbthe			
	2	3		1		,			16	-1	modled.			
-	,	1 5	5.0	35		'	=1		Ц	11	35 to 70			
-		4 T-	ļ	٠ 🚅	- Again	-	170				4.5			
ŀ		 	1.	1	1	1		-			Sand claret rlever send bring			
	>				. 254	· · · · · · · · · · · · · · · · · · ·					to component must weet			
	smre,			ŀ	1		0	150	He		in 2005 Sunder Fine comined			
	8					}	١٧	12,	~H	- ·				
	117	2	0 0	13		1.			و	1	710 to 10.0			
ı	3,74	+	1 6			/	0		H -	Į.,_				
	\													

	FI	ΞL	D)G	0	F	30	RI	NO	G (C	ON	T'	D.)	5	HEET	==	.0F_ <u></u> _	<u> </u>	
	SAMPLER		ERED	SAMPLE	FIELD LAB. SAMPLE NO.	KED LAB. MPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	-DEPTH (FEET)	•	PRO	JEC7 پاہم تن		FB		BOR	ING NO).			
	د ر معلام د عدیده ک	5.0	ع. بی ا	المنادة المناد	/	/	0 0	CL	2 3 4 5		<u> </u>	plv.	st, stici)	19	slish -5	stit Hy	t , n	i de Hed	nd e's		
	3.301.4 BANNE	5:0	01%	Breed	1	/	0 0	sw	20 20 21 22	100 mm		m	on s	sen,	e e t	+rc 16.5	sa_/3	17' 1	losts	<u> </u>	
		57 S. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7.	Charact	my Xxxx	'n			CL	2.3 2.4 2.5 6 7 6	1 3/1/2			trace the	1 40 0 5 t	-+',	501 1.0	of al	lay	h sro	- -	1
												Tx	22 A	b, ens	g.	10 k f	ly in	C/	1/2 w	_	
: -	-			2447								7	-D = 2	.5				2.00			



FIE		ה סו	مَـ	G	OF	- E	301	RII	NG	SHEET OF 2
PLA	N =									PROJECT BORING NO.
								_		EAREN AFR EITWO7
					1	(top)	የይናጥ			JOB NO. 3K98 LOGGED BY: LINE
	\ E	1170	יסי			,,,,				PROJ. MGR. GVG EDITED BY: SFN
										DRILLING COMPANY: A.V. POOL
9	-		١ ,	ı	\			ر_		DRILL RIG TYPE: 2 50 5-61
3.	1 3 X		, (NOT To SCAL	1	C				DRILLING METHOD: House Sten Augen
13	TA K)	SCAL	=)	0 9				DRILLERS NAME: VINCE BARKAZZO
Ankin	3)		ľ	'				TOTAL DEPTH (FT.) 30'
6	. 3				1		,			TIME STARTED 1515 DATE 12/13/91
	1									COMPLETED 1600 DATE 12/13/91
i				ORY R	RY					GROUND-WATER CONDITION AT COMPLETION OF DRILLING
				ABORATOR E NUMBER	ABORATORY NUMBER					parrel safe metel at 120
		<u>a</u>	_	Ø∃ R⊠	SON SON	_	0610			BACKFILLED, DATE
ER.	z	E	4 00	EAE		173	9	-		WEATHER CONDITIONS
MPLER	ET VE	FEET RECOVERED	图	2 E	FIXED	PPM S	LITHOLO	DEPT		PARTY CLOUDY 5 MPW WARD, 55°F
SAIT	유	벁	SSO	SAIS	SA	至	38	195		SURFACE ELEVATION
								Ц	X	COMMENTS
1		•				_		Ц,	:-	ASPHALT @ SUNFACE
1 28	2.0	-	~	-	-			Ц	7	0-3.5, Asphalt + Fill
								12	FM	
ı						7500		Ц		•
i	İ							3		- Fell at a
1										3.5-6.5; CLAYEY SAND + SANDY CLAY,
BARREL			١	-			SW.	4		AUTENATINE, SAND -COMEDITE
D A			3	10	1	X500	اعد			GRAINED ; CLAY - MODERATELY
1,	5.0	3.5	EXCE WEN	EIITW07	-			5		SUPT, DAML BROWN.
Speit			1 5	1 =				H	3:3	MOIST
30			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	U				6		CE-10 E. CLANCE SAID GIAS
				<u></u>		7500	<u> </u>		: <u>:</u>	6.5-10.5. CLAYEN SAND, YMEY,
	-		-						1.3	met.
		-				7500	اعر			wet.
	,		2 3					8	1	
	5		CENTENT	_	-				1:	
SPUR	5.0	5.0				7500	S 4	9	1:.	
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enter the contract of

FII	EL	D	LC)G	O	- [<u> 30</u>	RI	N(G (CONT'D.) SHEET - OF -
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	إساسا	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)	,	PROJECT BORING NO. ENTER EITHIO7 JOB NO. 3K98 ENTER JAK
	SEE			A GE		po		-11	_	10.5-21.0-BROWN-GREY CLAY, hard,
SPUL	o, v	0.2	Excelent	_		\$000 \$000	DCi+	14		
SPUR	8.0	0.0	E XCE LUENT	E11-TWD7-02		7500		17 18 19 20	-	21.0-22.0; SANDY CLAY, Soft, brown, saturated.
	5.0	1	1					24		MED. TO
RIT	3,0	1	1	\	-			-27 -28 -29	7	BETTLEEN 22-30 - COARSE TAND ALTERNATING W/ MOD HARD, DATHLE GREY CLAY, MOSTLY CLAY HORIZONS,
									2	
		- 1 Mary 1								



FIE		ם . כו	٥	G	OF	. B	O	RII	NG	SHEET OF
PLA	N =				Short	EME			_	PROJECT BORING NO.
					Sport		(6	um	<u> </u>	EAKER AFB ETT WOS GRE
1			~ .	.T. 1	~ C					PROJ. MGR. GVG EDITED BY: BFAI
			Ė١	m	0 0			Pum	m;	DRILLING COMPANY: A.W. POOL
									-	DRILL RIG TYPE: B-81 61
7										DRILLING METHOD: HOLLOW STEM AUGERS
MED 1A								Pum	دئ	DRILLERS NAME: VINCE BARRAZZO
1					٠					TOTAL DEPTH (FT.) 29
										TIME 0015 ALL DATE 12/14/91
										COMPLETED 0825 DATE 12/14/91
1				₩_	RY					GROUND-WATER CONDITION AT COMPLETION OF DRILLING SATURATED ZONES & + 1 10' and 21'
				ATO BER	RATORY MBER					
		8	2	ABOR	BON NUM	7	70010			BACKFILLED, 12/5/20 DATE 12-18-9/
8	z	ER	백립	EA.	34	CA	=	ΞΞ		WEATHER CONDITIONS
AMPI	FEET DRIVEN	FO	FS	FIEL D SAMPI	FIXED	HNU SCAN (PPM)	COE COE	DEPT FEE		PARTLY CLOUDY, MIN 405, 10 MPH WIND
38	E.B.	FE	ပ်လ	ES	FS	±e	<u> </u>	100		SURFACE ELEVATION COMMENTS
*								H	XX	
	0	,	1	ι	١	١,		H/		Aspitale @ Surface
Bi	4							H		FILL, 0-6.5', SAND, WELL SOLVED.
-								12	0	MED. TO COARSE GRAINED
	:							Π.	2 0	
							sw	[]3	1: !	
4					4		3~		1.1	
BARMEL					80				10	
A S	S	is	1		SBIIOSA	500	4	5		
7	N	as	රිකට	1	1					•
292			10		1 S.			6		
					E	-i.50=				
	- 0		***	-						6.5 po smoy cary know of
·			1			>500	ob			GRENT MOIST, HYDRO CARBON
-	ال						SC	8		CHOIL BELDING SANDIER - (-DEPOTH
	3 0		1 3	3	4		B		-	
1	BARRE L	S	Cucine	5 '	1	750.	0	9	-	
50.			14	ũ				H -		
1	ı	l	i	i	1 4	' I	ı	رم لت	ol i	

FI	EL	<u>D</u>	<u>L(</u>	<u>)G</u>	O	-	<u> </u>	K	N	G (CONT'D.) SHEET 20F2
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)		PROJECT FAKEN JOB NO. 3K98 EH SEOS EITWILD
						ISO	S W	, ,		10-11', SAND: MEDIUM GRAINED, WET, APPEAR & TO CENTAIN FREE PRODUCT
Sprir	S.o	8.0	FXCECUFNC	i	F11-54-581108B	15000 150	CH CH	1 2 3 4 4 4 5 5 6 6 7 6 6 7 6 7 6 7 6 7 6 7 6 7 6 7		11'-21' CLAY, brown of grey mottles, hard, plastic
SPUT	5.0	5.0	Exce LI BANT		E11 -54-581108 C	50	c.	18 19 20 21		21-TO CLAY, grey, hard, plastic, WET @ 21.
4.4	5.0	1	(ı	1	3		- 23 - 34 - 25 - ≥6	111111	SOME SAND ZONES PROBABLE BASED
718)	٥, ٩	1	1	1	1	,		26	1-1-1-1	
									2	
NO.	res:	-				J.M.Z.				

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FIE		ם ו	مَـ	G	OF	- 2	Ю	RII	٧G	SHEET OF
PLA	N =									PROJECT BORING NO.
			Ţ	!	3412	PET	75		•	EAKER AFB EITWILD9
			(ļ			1		-	JOB NO. 3K-98 LOGGED BY: URE
				ا)'			PROJ. MGR. GUG EDITED BY: BFM
				Du			1			DRILLING COMPANY: A.W POOL
٠		, cs (2	01	ومعوه	٥,٤٥	0	Ent	~1100	DRILL RIG TYPE: B-BLEUB- 61
(-11	1m1		יכ							DRILLING METHOD: House soon Angen
							}			DRILLERS NAME: V. BARRAZZO.
										TOTAL DEPTH (FT.) 25
										TIME 0925 DATE 12/14/91
				·						COMPLETED 0955 DATE 12/14/11
				ERY ERY	₩				1	GROUND-WATER CONDITION AT
					RATORY					saturated at 1 10 and 2 21.5
		0		SS	OR/ UME		ပ		19	BACKFILLED, DATE
ER		83	П _S	LABOR/	E S	CAN	0000			WEATHER CONDITIONS
AMPL	FEET DRIVEN	- <u>8</u>	현	ם	면	HNU S((PPM)	LITHOL CODE	ET		CLEAR, LAPER 305, 1010 MPH WIND
SAL	E E		SA	FIE	SA	로리				SURFACE ELEVATION
									斑	COMMENTS
1.									•	Aspitalt @ Surface
-	2.0	-	-	-	-	-		∐′	FM	
8								2		0-4,5 Fil, MOSTLY MEDIUM
	-						5√	Ц		GARINED SAND, WEEL SOMED
							`	∐₃		
									. :	
					94	2000		M.		
					54-Tw1109A			M.	-	4.5-6.0' CLAY, DARK BIRCHNISH GREY,
	5.0	3.5	6000	-	13		CL	15		MODERATELY SOFT, SUCHETY PLASTIC
S.B			9		3	250	СН			TRANSITION INTO LOWER BROWN CLAY
					2			6	==	SANDY
					FI-					6.0- 9.5' CLAY . REDONN BROWN ,
	\\ \\ -	·, .	_	1	-	Sene	30	147-		GNEY MOTTLES SOME SILT.
		1.			8			H		
. : = :		i.		1	-Tw1109	.		. 8	1=	
			Ω		13	>500	4	M	1	NEO 1
S. E	3 5.0	4.0	8000	-	3			9		9.5-10.5' SAND, FINE GRAINED GREY;
			"		5			-		WET FREE PRODUCT APPEARS TO
				1		7500	95w	/U.,		GE PREJENT.

	FIE	ΞL	D	L()G	01	F	30	RI	NO	G (CONT'D.) SHEET OF
	SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED		FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)		PROJECT BORING NO. JOB NO. 3K98 EIITW1109
							50 V		11		MODERATELY PLASTIC, ABUNDANT FER
	S.B.	5.0	5.0	ERCEUENT	_	-	i6	CH	13	1 1	CONCRETIONS, MINOR SILT, MOIST. -TRANSITION INTO LOWER UNIT 15-19.5 CLAY, GREY MODERATELY PLASTIC. MINOR SILT; DAME. SUGHTLY MOIST
-	S.A	5.0	5,0	CACELENT	-	EI(-Su-TWII09C	0 0		1 8 1 9 20 2 /		19.5-25? SILTY CLAY, GREYNISOME LT. BAN LAMINAE, SCFT. WATER NOTED @ ~ 21.5'
	BIT	-	_	-	-	_	-		- 3-3 - 3-4 ->-5		TD =25'
									7		
										1	
							2.00 d			2	



			712		
FIELD	<u> LOG 01</u>	F 201	<u> </u>	6	SHEETOF_2_
PLAN					PROJECT BORING NO.
	5406	PPETTE		- 11	EAKER AFB ETTTWO JESS S/31/92
1	L				JOB NO. 3 K9 & LOGGED BY: UNE
		!		ł	PROJ. MGR. GUC EDITED BY: BFN
	(Orz bent & 122)	0 EIIT	WID		DRILLING COMPANY: A.W POOL
	CANONY			Ì	DRILL RIG TYPE: B-61
	DISPENSERS	@ Elite	v09		DRILLING METHOD: HOLLEN STEM AUGER
-					DRILLERS NAME: V. BARRAZZA.
	VACUUMS			İ	TOTAL DEPTH (FT.) 25
		. 1			STARTED 1322 DATE 12/14/91
				÷	TIME DATE 2 14/91
	≿ ≿				GROUND-WATER CONDITION AT COMPLETION OF DRILLING
	NUMBER NUMBER NEGRATORY				SATURATED I 8.5
	BORATOI NUMBER BORATOI	ပ			BACKFILLED, DATE
	NA NA NA	CAN			WEATHER CONDITIONS
	12000 C	100 m	FE		CLEAR, MID 405, & LO MPH WIND
SAMPI TYPE DRIVE FEET	SAMP SAMP SAMP SAMP SAMP	CODE CODE		a =-	SURFACE
SH COLUC	TOOLE OF LEG	<u> </u>		°	COMMENTS
			H 1	0)	Aspitau e Surface
BIT 2.0 -	- - -	-		١,٠	ASTIMA C GALLACE
			$H \mid i$	FM.	0-25' Fu (NOT RECOVERZED)
		+++	- 2	1 1	0 8.5 110 (661)
	1 /	- 100 SC		<u> </u>	2.5- 4.5, SANDY CLAS DAPLE BROWN,
	હ	100	3	_ <u> </u>	Onenvic ricit
	1 1 1	t			Ordan ic local
			4	\$ \$	- Thansitud W/ Lover unit
S.B. 5.0 4.5		3 >500		<u>د</u> 	4.5 - 8.5' SANDY CLAY TO CLAYET'SAND,
1-3,5,0,4,5	0 1		5	- [Brown of GREY MOTTLES, MOD. SOFT,
	i g	3		_ =	Pamp.
			6		Printed :
		7500:			
	0			<u>-`</u> .	*
			8	= :	
		3 300		·Z	1
S.B. 5.03.	7 1	7	9		8.5 - 9.5
		<u> </u>			8.595 TR CLAYEY SAND BROWN W/
		= 20	10,0		GREY MOTTURS MOD TO FINE GRAINED

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	FII	ΞL	D	L()G	0	F	30	R	IN	G (CONT'D.) SHEET ZOF Z
•	SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)		PROJECT EAKER AFB JOB NO. 3K98 EII TWILLO
									1/	-	85'95' (CONTINUED) WET IN SAND ROUF. 95'-13' CLAY HAND, PLASTIC, BIROWN
ř	S.B	S.Ø	5.0	EXCELLENT	-		0	CH	1 12 13 14 15 16		MGREY MOTTLES MINOR SILT, FE STRING and Acdules. DAMP. -TRANSITION ZONE MGREY CLAY BELOW 13-22 CLAY GREY, HARD PLASTIC, SOME RED STAINS, MINOR SILT
	S:6.	5.c	5.0	CYCELLENT		1	0 0		16 15 15 16 16 16	7	22-25' BIT (NO MICOSEMES)
	BIT	_	_	_	-	_	_		75	-	
											TD=35:44
										3 4 5 6 7 8	
	NO	ΓES		•					- (υ.	

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PLAI					N					PROJECT BORING NO. EAKER AFB EII TWIII
										JOB NO. 3K98 LOGGED BY: BFM
	65									PROJ. MGR. GVG EDITED BY: BFN REN
	48.00	,	CAHOR	1				1		DRILL RIG TYPE: mobile, 861
					J				ž	DRILLING METHOD: 644" Hollow Sten Augens
	المياه	1			_				2	DRILLERS NAME: V. Burrazzu
	=	273	راعات	\$7v4183	3)	•			ج	TOTAL DEPTH (FT.) 221
1	pull			•					-	TIME STARTED 6753 DATE 12-15-91
4										TIME COMPLETED 08/8 DATE 12-15-5/
				TORY	TORY ER					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Softwarford at 210 and at 21
				₹ B	Z O		ပ			BACKFILLED. DATE
ER		RE	O	FIELD LABOR SAMPLE NUN	ABO	AN	THOLOGIC			WEATHER CONDITIONS Cleur, coid, listbreeze & 30°F
드 교	EN	S-	PLE	PLE	102	HNU SCAN (PPM)	오피	ET.		cleur, cold, list ore 200
SAMPLI	ASE PE	HOE HOE	MOS	AEL	FIXED	至		DEPTH (FEET)		SURFACE
0,,			0.0						- Por	COMMENTS
			i	١.	١,			H	5 79	Ashiell at surface 0.0-03
30/10/		^	1		1			口'		
8 8	2	0						Ħ.	v1 0	Fill; cravel mixed al fines
								2		9.3-1.0'
	i							Ⅱ.		
İv			į				SW	3	0,6	Fill: Sand board to stay board
1 3						7 504	4			medium to course sained loose
1 2							770			1.0 +0 7.0
16										
13				1		7500	d 15			
70%	7	1	3	1	'	,	7500	16		clay brown, with silt and
3		4	POOR	1				Ц	1	trace of sand moist, soft
	-							=	-	to medium stiff, parties
7							٠.		1	
- 01						74,24		B	7.	Suturated zone XIV
10				N			Se	1	1-	Surly zine al clay in very
1			1.	11/1		757	cots?	و	-	incist to net, soft
130%1	5	16	1 35	1				H-	1	10 40 11.0'
7		l	15	١ ا ن		60	ان	\sqcup_{n}	宁	

FII	EL	D	LC)G	O	FI	B 0	RI	N(G (CONT'D.	SHEET 30F 3
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)	•	PROJECT EAKEL AFIS JOB NO. 3KGR	BORING NO.
.7.						600	CL	2 3	いいにいい	Silty clay , bre me methed zea shee 11.0	es, very moist, melian
145.5 12	۶,	4	500c	-	1	600	CL	5 6 7 8 9	1.111114	Clay , Here signed plastic , summer 16- 22'	y, noist very stist
4.1105 5	, 5	٠, ٧	1000		1	0		- ZO - Z - 3	1	Switnated 24.00	af 22/1
								6 7			
							=				
 NO.	TES:										
. 10		•									



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1E		וכ		G	OF	3	O	711	NG	SHEET / OF Z
ΑI										PROJECT BORING NO.
										FAKER AFR EITWILL
_		_,								
	4									PROJ. MGR. GV G EDITED BY: VSB
\	NE"	}-	"HO	PY /	7					DRILLING COMPANY: Pool
1	<i>-</i>		عوفاه	HSERS						DRILL RIG TYPE: MOSILE BOI
,-		•		. danw	112					DRILLING METHOD: 6 4 Hollow ston Augus
			USTG	DTW.						DRILLERS NAME: V. Barra 224
ما	Laulij									TOTAL DEPTH (FT.) 25
V										TIME DATE 2-15-9/
										COMPLETED 1030 DATE
				FIELD LABORATORY SAMPLE NUMBER	RATORY MBER					GROUND-WATER CONDITION AT COMPLETION OF DRILLING SATURALE ZENES E8-5 JUN 5 and E21
		a		ORA	ARA MB		ပ္			BACKFILLED. 13:40 DATE 12-16-9/
.	_	ERED	TION TION	ABI	E S	AN	90			WEATHER CONDITIONS Clear, cold, lish breeze = 3000
H	VEN VEN	-S	를	FIELD LA SAMPLE		JSC W	LITHOL	HH.		Clear, edd, 1134+ breeze = 30°F
TYP	J. P. E. E.	REC	SA	SAN	SAN	NE P		FE		SURFACE ELEVATION
									**	COMMENTS
								Ħ	-00	Asphalt at surface 0-0-0.3
1					1			Π′	- 3	
118	2	0				'		H	أبدا	Fill: Gravel clust mixed ulfine
		<u> </u>	<u> </u>		1			12	EW	0.3-1.0
	:							H		
						75000		3		Sandy alav , con Isone s'H
						7,		H		moist set fore descrits
N]	H		Court la cer presible fill
KO		\ .				300	CL	H	1	1.001 1.001
BACKC						179	Sc	H5	-	story hydrocacher over.
,			100	11	1			H		
170	16	13	100			A ³		H6	1:	
,			6			1"		Н		Sand seam & 8' 10 8.5', sutruke
'n		100					3	17	-	
			71.72	- 70				Ц	1:-	Sund Scam 2 10 to 10.5' sutured
101		-				5500				
3 76							Sin			Clay content begins to increase
1			;		1.			$\prod_{i=1}^{n}$	-:	below 10.5'
30417	1:	:		3 1	11	7500	ر کا	واا	- :	
. 3	1 2	"	, ,)			12	}	-:-	
٩	I	l	l	1.	ı	1	ICI	-4,	او	

FII	EL	D	L() <u>G</u>	0	F	<u> </u>	R	<u>N</u>	G (CONT'D.) SHEET ZOF Z
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	LITHOLOGIC	DEPTH (FEET)		PROJECT EAKEL AFB JOB NO. 3K98 EIITWIIIZ
						75°°		H"		
5, 5417 Baus.	6	4	goor.	1	1	3600 ;0	CH	13		Clay brownish stay, slightly mattle 1, maist medicastiff Some silt, brove of sont, plustic 10.5 - 15.6:
5' SPLIT BARRES	45	ک	Soud	1	1	0 0 0	C#	1 5 20		Clay, blue stuy, moist, stiff
1:10	140m	ole of spaining	but El	25				22		saturated 2010 at = 21'
								2.5		T0=25'
								Π	9	
									2 3 4	·
		V-Applica	=					H	6 7 8	
NO.	TES		+ 		1	T	1	- u (<i>0</i> 1	U.S. Santa and A.



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F	TE) i	مَـ	G	OF	: E	Ю	RII	NG	SHEET OF
P	LAN			1	3× of Pet	_					PROJECT BORING NO.
İ		•		इम	of Pet		Nor				FAKER AFB EILTWILLS
	7			<u>_</u>		!					JOB NO. 3K98 LOGGED BY: LRE
- 1.	ال الله الما										PROJ. MGR. GUG EDITED BY: BFN
1 7	<u>j</u> , !					2 . (22)			-7		DRILLING COMPANY: AW POOL
1	J (- CAE	DIAN			ひ		DRILL RIG TYPE: 8-61
	, ,	(_	11 TW	a /	' •	DRILLING METHOD: HOLLOWSTEN AUGEN
	j				~@(inoi		F /		DRILLERS NAME: U. BAYLRAZZA.
	G	ras	5		*/	~70′	4	¥	4		TOTAL DEPTH (FT.) 27
	-	•	-6	-			EIIT	w(II)	3	پ	STARTED 1350 DATE 12/15/91
L			*		'IP			4			TIME COMPLETED 1445 DATE 12/15/91
=					ER	FR					GROUND-WATER CONDITION AT COMPLETION OF DRILLING subvaled zones at 5 to and 22 2
		1		- 1	<u> </u>	20		ပ			BACKFILLED, 0739 DATE 12-18-91
ا	<u> </u>		핆	. S	FIELD LABOR SAMPLE NUM	AB S	CAN	.0GIC			WEATHER CONDITIONS
· 1.	7	_Z		띎	温	PLE	2		ĦŢ.		CHEAR SMPIR WARD, MIDYOS
. 12	TYP	⊞≶I		ZZ ZO	교통	FIXED	NA MA MA	ITHO ODE	급		SURFACE
۲	-ומ	<u> </u>	<u> </u>	ဖပ	FO	H.S	I	70		1 prk-	COMMENTS
j									H		
1	4	0	i	ı		ı	١	ML	Η,	NF	GRASS C SURFACE
	8	0			1			• • • •	H		
+									2		0'-3' PLOW ZONE + POSSIBLY FILL.
,	:						٥	SW		٠٠٠	2-3 MED. TO COARGE BRAINED
· į									3	-:-	SAND, DAMP, SOME BLACK GREANICS
	4							CL			AND RED TRON CONCRETIONS
	BANNEL										3'-4.5' SILTY CLAY, D'ARK BROWN
1	B	5.0	5,0	0	1	1	0		M	=	VERY MOIST SOFT, MOD PLASTIC
}		S	N	Good					15	= 7	4.5-10' SILTY SANDY CLAY, LT BROWN
ļ	SPUT			9						-	W/ RED + GREY MOTTLES,
	S	1							II.		BECOMES LIGHTER IN COLOR WDEPTH,
14.				-		+	0			:	MORE GREY WI DEPTH.
									IF	;	ZONES HAVE WATER IN 8-10' DITERES
	4						0	+		-	SANDY DUTENIALS ANE 1'6 THICE.
	BANNEL	0	0							-	
		v	1 .	100						: =	•
	SPUL			Gooct						-	
	SP	i					0	INL	-111		
	ı	•	•	•	•	•	•	•	-10	, •	ريدون و مناشق مي .

	FIE	=1	D	1.0	G	0	F	30	RI	NO	G (CONT'D.) SHEET 2 OF 2
	SAMPLER TYPE		ERED		FIELD LAB. SAMPLE NO.	ED LAB.	IUSCAN PM)	10LOGIC E	DEPTH (FEET)		PROJECT EAGUER AFB JOB NO. 3K98 EITWILL 3
	0)1		<i>ا</i> ل ک		PAC		0		11	-	10'- 21' CLAY, LT BROWN TO GREY. SILTY: RED IMM STAINS 12-21'.
ž	S.B.	5.0	5.0	CACELLENT	1	1	0	CH	- 13		- BECOMES GREYER I LESS SILTY IN 12-19.5 DNITEMAL, PLASTIC, HARD -19.5-21, BECOMES LT BROWNIGH
	S.8	5.0	5.c	EKCELENT	E1113-01 @33'	(2 7		16 13 34 3-	1	RED, LESS PLASTIC, MORE SILTY THAN ABOVE 21-27 SAND, COARTE GRAINED, MOD. WELL SORTED, WET.
					13			- SV	2 2 2 2	5 ,	22'-27 IS SANO (as per drillers connects TD =2-7'
	NO	TES	7.7				-			9	



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FIELD LOG OF BORING	SHEET 1 OF 2
PLAN	BORING NO.
EAKEL AFB	EII TWIII4
JOBNO. 3K98	LOGGED BY: URE
PROJ. MGR. GVG	EDITED BY: BFN
	A.W POOL
DRILL RIG TYPE: B	-61
CPASS DRILLING METHOD: H	DUOW STEM AUGER
FIELD DRILLERS NAME: V	. BARRAZA
	24'
TIME STARTED 6955	DATE 12/16/91
TIME COMPLETED [105	DATE 12/16/91
GROUND-WATER CONDITION GROUND-WATER CONDITION GROUND-WATER CONDITION GROUND-WATER CONDITION BACKFILLED, TIME WEATHER CONDITIONS	on AT Sine at t8 and t21'
A B A B B B B B B B B B B B B B B B B B	DATE
BACKFILLED, TIME WEATHER CONDITIONS	
CHAIL, MID 305	5 mou id alo
NO NO NO NO NO NO NO NO NO NO NO NO NO N	, 5144
SCIEDIES SOLO ES ES JOIGS ELEVATION COMMENTS	
GRASS @ SURFI	ia CE
Bit 2.0	
4.8-S.0 SAND	MED GLAINED, MOIST.
	-
S.B 5.0 3.0 0 1 1 0 5 - 5-6' Sivry Cury	DARLE BROWN, MOD.
	THE PLASTIC MOIST.
CH - MINON SAN	
SANON	SILTY CLAY FROWN
of Garay	MOTTLES. SUGITING
	c, fusik Iron status
12'-13'	
WET ZO	ONE 8'-10' IN MORE
5.6 5.6 4.5 3 1 1 0 SANON	BOYSE INTERNAL!

-11	ΞL	<u>.D</u>	<u>L(</u>	<u>)G</u>	0	-	<u> </u>	RI	N	G (CONT D.) SHEET 3 OF 2
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	FIELD LAB. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	L/THOLOGIC CODE	DEPTH (FEET)		PROJECT EAKER AFA JOB NO. 3K98 EII TWILLY
s.B				PAG		υ		1/	1 1	-Transinow Wilover Gray UNTI @ 13'
S.B	<i>5</i> . 0	5.0	ERCECLENT	-	-	0	CH	13		13-21' CLAY, GREY, HARD, PLAITIC, PCO TROWSTAINS 13-16'. -BECOMES HARDER + MONE PLASTIC M DEPTH.
S.B.	5.0		ERCEUGNF	1-61119	-	0	SW	18 19 20 3/	111	21-24 SAND, COARSE GRAINED; WET;
BIT	2.0	-	-	-	-	-		3 4 5 6		MOO. WELL SORTED WET @ ~ 24' TD = 2-4
								9 0 1		
					120			5 6 7 8		
ron	 ES:	*	As p	er di	-i (lea	s Cu	mone	H 9		

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FIE		וכ	0	G	OF	. B	OF	211	NG	SHEET 1 OF 2
PLAI										PROJECT BORING NO.
	•			•	3			PARKI		EAKER AFB EITWILLS
								OF	•	JOB NO. 31498 LOGGED BY: file
i"							١.	B×		PROJ. MGR. GUG EDITED BY: BFN
								Sitorase	176	DRILLING COMPANY: A.W. POOL
			(FUT	ر ۱۱ اغ ا	3	1			DRILL RIG TYPE: 8-61
		Gan	s 3				1			DRILLING METHOD: HOLLOW STEM AUGEN
				EU	TWIII	15	1			DRILLERS NAME: V. BARRAZA .
				0			1			TOTAL DEPTH (FT.) 22'
							'), (TIME 1320 DATE 2/16/91
			THE	π2 ο	PET					COMPLETED 1420 DATE 12/16/91
				H 2	FR					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Saturated Zones at + 7 and 17'
				MB	MB		a			BACKFILLED, DATE
æ		Ä	S		BE	CAN	_0GIC			WEATHER CONDITIONS
LER 3	FEET DRIVEN	2			PLE	SS =	=	TH T		CLEAR, MID to UPPER 403, WOUTHIND
AMPLI	EE.	E C	SAMPI	AEL	FIXED	HNU S(PPM)	二 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	DEPTH (FEET		SURFACE
SH	FO	T.E.	801	F.O.	II.O	1	<u> </u>			ELEVATION COMMENTS
								H		GRAN @ SURFACE
BIT	2.0	_	_	_	_	-		H ′		0-2 NO RECEIVENLY
					}			H		0 0 100 100 100 100 100 100 100 100 100
-				,		0	CL	12	;;	2-3' CLAY, DAME BROWN, ORGANIC
	i								-	RICH, ABUNDANT ROOT HAIRS. MOIST
İ		- 2					мL			3-9' CLAYEY SANDY SILT/SILTY SANDY
							ML		_:.	CLAY; BROWN, SILTY ZONES MONTHAN
			7			0			5	ARE MORE FINABLE THAN CLAYES ZONES.
D.B	5.0	5.0	FKCELLENT			'		5	-	ROOT HAIRS + ORDANCE @ TOP. MOIST
			<u>~</u>	-	-				_	
			X X					6	_	
7.7			W W			0			-	
-				4			. 21.2			
1		1.	1-		+	0	+			- WET ZONE ~ 7' WHENE MORE SAMA
			با إ	α	5		+	1	-	15 PRESENT
-			4	G		1				
5.	B 5.	50		<u>ا</u> ا	- -		10.	9	-	
			נייני	1-1211		"	CL		E	9-19' CLAY, BIROWNISH GREY WY RED
	1		u				'		-	MOTTLES, HARD PLASTIC. MINOR SD + SILT

	FIE	ΞL	D)G	01	F	3C	R	IN(G (CONT'D.) SHEET 2 OF 2
•	œ		RED		FIELD LAB. SAMPLE NO.	LAB. E NO.		L/THOLOGIC CODE	i		PROJECT EAKER AFB JOB NO. 3K98 EIITWIIIS
		SE	pr	ຝ.	PAGG	-			1.	-	- Tron STAIRS 11-12
í	S.8,	5.0	510	Steelle. &			0		12 13 14 14 16	#	
	S.B.	5.0	5.2	Creelles &	E1115-2 30'		0	Sc	18 19 20 20 20 20 20 20 20 20 20 20 20 20 20	タ マ・ ノ・・ -	19-22 CLAYEY SAND, LAMINATED, SANDFINE GRAIN - SAMPLE SATURATED @ 19.5'. VERY MOIST TO WET UP TO 17'. GREYISH BROWN WIREDOISH LAMINAE
										3 4 5 6 7 8 9 0 1 2 3 4 5 6 7	TO = 2-2-1
		2000	75.0				-		<u>-</u>	8 - 9	E



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FIE		וכ		G	OF	: B	OF	\exists I	NG	SHEET OF 2-
PLAI						i				PROJECT BORING NO.
1	5 1401°	PETE	,							EAKER AFB EIITWIII6
	2 1001	1	•							JOBNO. 3K98 LOGGED BY: JAK
			ረ ኮሚ ን				En	mil	ردا	PROJ. MGR. GJG EDITED BY: BFN
		- for	1.7		15		0			DRILLING COMPANY: A.W. POOL
'		1 AIR			Q					DRILL RIG TYPE: 8-61
					378					DRILLING METHOD: HOUSE JOEN AUGEN
									Ì	DRILLERS NAME: V. BARRAZA
										TOTAL DEPTH (FT.) 201
					\	/	\			STARTED 1530 DATE 12/16/91
							7			COMPLETED 1428/600 DATE 12/16/91
				₩~	RY					GROUND-WATER CONDITION AT COMPLETION OF DRILLING
				FIELD LABORATORY SAMPLE NUMBER	ABORATORY E NUMBER					SATULATED ZONE ! 10 and
		03	,	S.M.	30R	_	210			BACKFILLED, DATE
ER	7	ERI	m _S	EN	AA	CAN	9			WEATHER CONDITIONS
SAMPLER TYPE	FEET DRIVEN	FEET RECOVERED	SAMPLE	35	FIXED L SAMPLI	HNU SCAN (PPM)	LITHOLOGIC CODE	DEPTH (FEET)		CLEAR MID 505, UGHT WIND
SAI	HR R	HH HH	80	SA	ES	<u> </u>	<u> </u>	8 <u>F</u>		SURFACE ELEVATION
								Ц		COMMENTS
	عر ا	*			_	_		Ц,		GRASS & SURFACE
815	\d.C							Н		0-25' No NECOVERY
								2		
						0			-:_	25-6 SILTY CLAY BROWN WY RED MOTTLES
			7					3		A.5 6 STAY COMY, SHOWN WITED HAT REE
									=	
							CL	4	-	- Moist Halle
SB	5.0	4.5			1		-		-	- Indis Append
		"	। २) `		0		5		
			5		'					6-10.5 CLAYEY SANDY SILT, BREWN W/
								6		REDOISH MOTTLES, VERY MOIST.
.	:=	100.0				0	ML	-	-	- WET IN ZONES WY LESS CLAY LAMINAE.
	+-		9-44	y as		+-	†			
1				,01	۵	0			Δ.1	
				-						SATURATED IN COME BARREL @ "8" IN 6"ZENETHAT
5.	g 5.	o H a	٤	2 -				9	·	LESS CLAYEY.
		1,4			= '	0			-:	=
				1 it	1	1			1:-	<u></u>

OG OF BORING (CONT'D.) SHEET ZOF Z BORING NO. PROJECT LITHOLOGIC CODE SAMPLER
TYPE
FEET
DRIVEN
FEET
RECOVERED
SAMPLE
CONDITION FAKER AFB SAMPLE N SAMPLE N FIXED LAE SAMPLE N HNUSCAN (PPM) EIITW1116 JOB NO. 3K98 Brownith 10.5-12.5, SILTY CLAY GREY W REDOKH MOTTLES, MODERATELY HAMD PLANTIC CL NEWS WOIL O CLAY 7210M , 7702.00M PLASTIC. SOME SILTY ZONES. S.B. S.0 5.0 CH 0 - REDDISH HEMATITE/ LIMONITE 16 @14-16' Ó - 17-19' WET MORE SILTY THAN 0 DRIEK ZONEL ABOVE + BELOW. HE SB 5.0 5.0 O - SMALL HEMATITE STAINS 18.5-201 0 22 TD = 22 Me.al Hart NOTES:

* WATER ON COME BACKER @ 21'





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		XOR	POF	ZAT						(m.e.,
FIE	EL	D	LO	G	OF	<u> </u>	30	RII	NG	SHEET 1 OF 12 12
PLA	N-	- 10		Ī	1:	100	100	7 1	111	PROJECT BORING NO.
							ليا			EAKER AFB (FIITWILL)
						٥	2439 13439 1147)	0	JOB NO. 3198 LOGGED BY: LRE
									- 1	PROJ. MGR. GVG EDITED BY: BFN
			1	1		Ę	EIITW	0		DRILLING COMPANY: AW POOL
			1	1		•	- • • • • •	(Ч	DRILL RIG TYPE: Howen I per Harris BFN
			13							DRILLING METHOD: HOLLOW STEM AUGER
			\	۱ ځ	PiAi4 I	Lie (W)	a u	; (DRILLERS NAME: V. BARRAZA
					 					TOTAL DEPTH (FT.) 12
			'							STARTED 0815 DATE 12/17/91
				,						COMPLETED 0826 DATE 12/17/91
				RY ₹	RY				·	GROUND-WATER CONDITION AT COMPLETION OF DRILLING Saturated zone at ± 8.5'
				ATORY Ber	RATORY					· <u>-</u>
		ED	z		0	,	ည္သ			BACKFILLED, 1622 DATE 12-17-9/
ER	z	/ER	TION	LAI	EA.	CA	0000	±C		WEATHER CONDITIONS
SAMPLI	FEET DRIVEN	FEET RECOVERED	PON	FIELD LAI Sample I	FIXED	HNU SCAN (PPM)	CODE	DEPTH (FEET)		CLEAR, MID 30s, 5 Mg H WIND
SA	ER DR	FE	80	FIE	SA	£₽	38 30 30	<u>ar</u>	,	SURFACE ELEVATION
								Ц	≫	
L	9	6.	1	٠,	,	, ,		Η,		ASPHALT @ SWEFACE
\$	જ							H		
								2		0-3.5' NO NECOVERY
					1			Н		
1			,		0	0		3	٠.	22 5 1 2 4 5 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
BANGEL					ALIIM				17. 7	3.5-5.0 CLAYEN SILT, DATUL BROWN,
Ž			,	·	5		ML	4	- 1	ononne Honord, Dry.
8,	5,0	\vec{8}{\vec{8}{3}}	وعود	1	1	8	"		1-1	5.0'- 9.5' SLUTY CLAY REDDISH BROWN
7	3,	נאז	B	1	1 7			5		WHORE MOTTLES BECOMES GREYER
<u>C</u>		İ		Ū	0			W	-	M DEPTH. MOIST TO WET.
5			Ì	U	EII	0		6	!-'	- WET IN MORE SILTY HOTHON' (SER BELOW)
						7				OSTRON C HANNEL AND DOOR
1	Ι,	<u> </u>		1		9	CL	N		
32			F	=		36			Z-	CONTROL OF THE PROPERTY OF THE
Brrace			4					8		- 8.5 to 9.5 WET, FREE WATER
1	0	Q	cere	1	1				-	VISIBLE IN TWO 4" ZONES
してるい	Ŋ	5.0	1 2	!	1'	20		9	1-	9.5-12' CLAY GREY WIT BOW MOTTLES,
5			ا ا			-	10:	M	F-	SLUTY; SOME REDDISH-BLACK STAINS (FE?)
•	•	-	•	•		17	1	11	· -	PLASTIC, MOD. HARD MOIST

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	FIE		D		G	OF	E	30	RII	NG	SHEET OF
	PLA					AND					PROJECT BORING NO. EAKER AFB EITTWILLS BEFORE CO
					رد			<u></u>	\	1	JOB NO. 3K98 LOGGED BY: UNE
	}					E	1170011	09 E	بر الماسال	BX	PROJ. MGR. GVG EDITED BY: 6-N
		ا	SPEI	~ L	s P		ĩ	6	9		DRILLING COMPANY: A.W. POOL
				\int_{0}^{∞}		~30′		EILTH	7 וווי הייטו	\ <u></u>	DRILL RIG TYPE: How Speks Augen
			STITEE	/".,	1				3		DRILLING METHOD: its/lowstein Augens
		•		١	$\int_{\mathcal{C}}$				ا 1119ء		DRILLERS NAME: V. BARRAZA
. d			1 3								TOTAL DEPTH (FT.) 12
			` `	Fi	<u> 4::</u>	_])			(F	TIME DATE 12/17/91
			/		\ '	A KIC	4 ms n	, ,	1veh	رد	TIME COMPLETED 0920 DATE 12 17 19 1
					R R	ABORATORY NUMBER					GROUND-WATER CONDITION AT COMPLETION OF DRILLING Saturated Zone at 1 8.5'
					ATC	BEF					li .
			9	z	FIELD LABOR SAMPLE NUN	S S	Z	LITHOLOGIC			BACKFILLED. 16:35 DATE 12-17-91
	ER	z	VER	바	LEA	AA	HNU SCAN (PPM)	Ö	TE		WEATHER CONDITIONS
	₹ E E	ET VE	COL	MP	NP P	FIXED	D.M.	三三	DEPTH (FEET)		CLEAR, MID YOS, UGHT WIND
	SE.	표	FE	ဖွဲ့ပ	ES	ES	主の	122			SURFACE ELEVATION
•									Н	<u></u>	
	BIT	~~	0	_	_	_	-	-	H		ASPITALT @ SMIFACE
	31,	ن.ي							H		5 5 5
					<u> </u>	<u> </u>		_	2		2-5' Sitty CLAY, DARK BROWN
	i	:					0		H		TO GREYISH BROWN; SUGHRY PLASTIC MODERATELY HARD,
	i								3		- Ithorocarson open
	1							CL		-	11 / BINCHASSA SEVICE
									4	- '-	
		_	ر .				3			- , - , -	
	3.5	50	>.0						5	=	5-9.5' SILTY CLAY GRENUH BROWN
											LI RED MOTTLES SUGHTUS MOIST TO
-				1				CL	6	_	wer.
						1	2				- 8.5-95' WET IN MERE STUTY PONES
estes of the sector		-	-	+-	-	+	1	TCF		-	Two .3"-4" zones HERE of FREE WATER
A STATE OF THE STA					97		30	<u>-</u>	8		
					1	1			M°	又 -	
					F. E.				W -	'	9.5-12 CLAY, GREY W/ LT REPOISIN BEN
	SE	5.0	5.3		-	.^			N	-	METTLES, PLASTIC, MOD. HARD, MOIST
		-			80	5	190				
~	ı	•	1	•	' =	÷ .		1	11/0	/	The second secon

1	FII	EL	D	LC) <u>G</u>	0	F	<u>B0</u>	RI	N	G (CONT'D.) SHEET -OF -
	SAMPLER	z	/ERED	LE TION	FIELD LAB. SAMPLE NO.	Ι.	AN	LITHOLOGIC			PROJECT EAKER AFB JOB NO. 3K98 TWILLS
	ુ દુવ	ર્ષ	PRE	۲.	PAG	الما	0		-1/	- -	17' 12-36 CLAY, GREY: HAND, PLASTIC, ABUNDANT
	S.B	5.0	5.0	PROFUENT	l	`[0	CL	13 14 15 16 7	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	FE STAINS AND "NODWES FOLLOWNG OUT ROOT HOLES; MINOR SILT; DAMP 20' SILTY 17'-DOS' CLAY, BIRDWAISH GREY W ABWIDAM
	S.B.	Sip	40	EXCRUGAT	E1119-02	1	0 0	CL	8 9 9 9 1 9 2	17171	PED FR STAINS + "NCOMES", STUTY STR. -WET C 18' 20' - 21' 20.5/2 - 20 JAL CLAY, GREY, HARD, PLASTIC, ABUNDANT FR STAINS AND "NODWES" (SAME AS 12'-17'
									3 4 5 6 7 8 9 0 1 2 3 4 5 6		TD = 2Z
	TON	ES:		Change A				. : 	7 8 9		

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F	FIE)	_0	G	OF	E	O	<u> </u>	NG	SHEET OF 2
F	LA								اد	1	PROJECT BORING NO.
	{			カバ	4				ν.	4	EAKER AGB BX SIMPEHE TW1120
	\ !	~		~~ >);; 20	~~	^	_	7	´	JOB NO. 3 K9 8 LOGGED BY: 158
				١	2112	2)		PROJ. MGR. GVG EDITED BY: BFN
	-			8-					· ·	1	DRILLING COMPANY: A.W (301
١	i			Ì	90	rwii	3		ζ		DRILL RIG TYPE: Mobile 13-61
-	0	a						O 7	}		DRILLING METHOD: Hollow stem mager
	\$ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0) س	1115) ' _I ı	211 Y		DRILLERS NAME: V. Barazza
ľ	3)		TOTAL DEPTH (FT.) 30
											STARTED 1019 DATE 1-7-92
Į	1										TIME COMPLETED 11/2 DATE 1-7-92
					ORY R	RY					GROUND-WATER CONDITION AT COMPLETION OF DRILLING SATURATED ZONE AT 29' und 11' and 21'
						RATORY MBER					
-			<u> </u>	-	BORAT	BOR	~	310			BACKFILLED, DATE 19/12 SEE WELL WAPLES
	ER	z	Æ	4 0	E A	AH	CAN	01907	Ŧ.		WEATHER CONDITIONS weather conditions weather conditions
	APP	FEET DRIVEN	ES SEL	ES S	FIEL D SAMPL	FIXED	MAD (MAD)	COSE COSE	EPT		
	ZA T	FR DR	32	SAN	SA	문정	至	38			SURFACE ELEVATION
									Ц	• • •	COMMENTS
7	8 7			١,	١,	, '	,		Ц,		CRASS AT SWAFACE
3	D-2	7	1	'	·	'			Н	\	
<u>م</u> ۲								 	12		DIK BROWN - BROWN SILTY SAND W/
Ú	!	!							Н		SOME CLAY, ARGANICS AGUNDAN,
3000	i				•			SM	3	1: :-	SAND IS MED-COARSE CORINGD
										1	WAL SOCTED ATT + ROLL FRAGE.
Sout							0		77		FRIASLE, MOIST
		1							***************************************		0-6,
23.02.03	ľ	15	N		1	,	040	155	35		DERECUID - BROWN SILTY CLAY
			m	6		\ '			7		
וֹבְּיבְיּבְיּבְיּבְיִיבְּיִבְּיִיבְּיִבְּיִ				5	'		0		76		TR SAND 6-9 6-12
_ <u>.</u>	3						O.	1.		= :	TR SAND 6-12
-10	-	-	-	1		+		+	W/	-	SILTY CLAY TOO PROUS TO 9'
	<u>. </u>	-	.	1	: -		2	CL	1		(LT 151100 0 TO 1510000)
	300				-				8	-:	
	3650	1		1 3	} 				H	-	SATURATED ZONE AT 9': (9-9.5
į	2 1	$\iota \mid \iota \iota$	ע וכ	ן [i kacentera		4	A	9		
•	36217	1			V	.	'		1		SOY CLAY AS ABOVE, SATURATED
	اب	1	l	ł	I	ł	ı	1	W 10) ー`	11 11 -11

FIEL	D	LC)G	01	-	30	RI	N(G (CONT'D.) SHEET 2 OF 2
SAMPLER TYPE FEET	2			LAB. E No.	HNUSCAN (PPM)	OLOGIC	DEPTH (FEET)		JOB NO. 3K98 BORING NO.
50001) 50017 17-22 12-17	2/3	Free Contractions	FI	F	40300011100	17 D SC	1/2 13 14 15 16 17 18 19 20 21 23 24		LITHOLOGY FROM 6-12.515 PREDOMINANTED A SANDY CLAY (CLAYETSD STATURATED) ZONES HAVE CONSIDERABLE MORE SAND IL THEM (CLAYET SAND). GREY-BROIND MOTTLED CLAY W/TR SILT, SE STIFF & PLASTIC - MED. PLASTIC 12.5-27 (SD STRINGER AT 13 CLAY AS ABOVE - MOTTLEW L DECREPSES BEDOW 18.5' CLAY BELOM MUCH GRAYER IN COLLR RAPPLEZ WET AT 226 ZI J
80, 22-27 SPLS 20, 22-27 SPLS 20, 22-27		- מנפוסח	\$	1	0 0		28 29 30 1 2 3 4 5 6 7 8	1-	CLAY AS AGOVE SOFT, (SATURATED) PLASTIC, THACE OXIDE NODULES: AND I COALLE GLANNED SAND. TD = 30' Druller reports Clay to Ti

THRII KE



MWIIZO

					-					, , , , –
FIE			0	G	<u>OF</u>		O	RII	VG	
PLAN								<u> </u>		PROJECT BORING NO.
11		77.	> 1 4 4	4				, N	4	EAKER AGB BY SWOOTH TWIIZO
1 1	<u>~</u>	~	<u> </u>		<u>~</u>	^	_	7	/	JOE NO. 3K98 LOGGED BY: JSB
		1		20				j		PROJ. MGR. CUG . EDITED ET BEN
			2 -					٠,		DRILLING COMPANY: A.W (201
			4	0 1		3		. }		DRILL RIG TYPE: Mobile B-61
100							a	3		DRELING METHOD: Hollows : in my
COAD	J~!*	\$					0 7) را ۱۱،۳	÷	DRELLERS NAME: V. Barazza
8								}		TOTAL DEPTH (FT.) 30
					Θ.					STARTED 1019 DATE 1-7-92
										COMPLETED 11/2 DATE 1-7-92
	.			2	>				1	GRUUND-WATER CONDITION AT
		1			E E					Sommitted zone at 29' und 11' and 11'
						_	ō			TIME PARTY COMPLETION
E		ERED		E A	열	S S	000			WEATHER CONDITIONS PHY clouds, light breeze
로	KEN F	وَاحٍ.	逼	트립	유로	23	오범			
N S S S	E C	E	18	SAF	ES	至		HE		ELEVATION
								Ц.		COMMENTS
F 2 2				,				Ц,		GRASS AT SURFAIR
37.0	7	1	۱'	· i	,	•				
E								<u> </u>		DK BROWN - BROWN SILTY SAND W/
7								Ц		SOME CLAY DELAN.CS ASUNDAN
3.			- [SM	3.	1: :-	SAND IS MED - CORRECT PAINED
2									::	WAL SORTED ATT + 1 7CA FRANCE.
3			1			0			1.5	FRIASLE MOIST
1 1	ı,									0-6'
3 1	二	S	5	,		040	155	35		DI GORNIA - GREEN SILIY CLAY
3 6	기	m	5000	l				7	. :	Ви применя
- 2.		. }	J)	ľ.	1	0		40	72.	TR SAND 6 9 6-12
3		j				0		<i>[1]</i>	-:	TR SAND TO THE
		_			_	-	-		11	SILTY CLAY AS ABOUT TO 9'
		-				2	CL	H	-	(LT Blow) TO BLOWN
reco.		1	1-					8	-	
Mons reco.			3							SATURATED ZONE AT 9'. (9-1.5'
Sent sent	3	13	excercent			4	4	1		
3 2	- 1		25					1		SOY CLAY AS ABOVE : SA CARATED
A! !	1	1	ļ	i	1		•	W 10	?• -	20-E 11-11.5'

SAMPLER	EEL BRIVEN	RECOVERED O	CONDITION	FIELD LAB. BO. SAMPLE NO.	FIXED LAB. SAMPLE NO.	HNUSCAN (PPM)	O Section 3003	R	NO	PROJECT EAKED AGS BORING NO. JOB NO. 3K48 TWILZO
ארניר הי			していて		1	4 0 3	SC.) <u>1</u> ; 2 ; 3		LITHOLOGY FROM 6-12514 PREDOMINANTO A SANDY CLAY (CLAYERS SO SITURATED) ZONES MAKE CONSIDERABLE MERE SAND IN THEM (CLAYER SAND)
Special Special		\o	UT PREPLEN		-	0	CL	15 16 17	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	GREY-BROWN MUTTLED CAY WITH SILT, SI STIFF , PLASTIC - MED. PLASTIC 12.5-27 (SD STRINGER AT 13
5000 S	5	5	- Kreneni	1	<u> </u>	1	¥	20 21		CLAY AS AROVE - METTLEVIE DECREASES BELOW 18.5' CLAY BELOW MUCH GRAVER IN COLLE- BARREZ LIET AT 226
C2000	5	5	aranan	I	1	0000	ИL	23 74 25 26		CLAY AS AGONG SOFT, (SILTHEATHIN) PLASTIC, TRACE OXIDE NODLIUTS AND I
Aubent to	3	\	1	1	Į	. 1	·	28 29 30		TD=30' Julles reports
				, ,			- T	3 4		
								6 7		

NOTES:_

Halliburton NUS FIELD LOG OF BORING

WELL NO. MW1121 SHEET _ 1 _ OF _ 2 ____

101		<u>COR</u>	PUR	AHU	17						_		
PROJ	JECT:			EAK	ER /	AFB F	RFI		JOB			01	
									LOG	GED	B	<u>/:</u>	BDH TOTAL DEPTH OF BOREHOLE: 16.7
DRJL	UNG (CONT	RACT	OR:			tate		ng				SURFACE ELEV.: DATUM:
DRIL	LER'S	NAM	E:	10		The second	9923						START TIME: CR8 DATE: 4/8/95
ORIL	L RIG	TYPE:		OC.	ME	_ {	13						FINISH TIME: 0920 DATE: 4/8/95
BOR	NG M	ETHO	D:	H51		·	,						WATER DEPTH:
HOL	E DIAN	METER	:	74	// 	10-4	<u> </u>					DATE:	
SAM	PLING	MET	HOD:	1	ndia	ivon	1_			<u> </u>			TIME:
HAM	MER	WGT.:		NA	1		DRO	HOT	· /	14			BACKFILLED, TIME: DATE:
SUR	FACE	COND	ITION	s :		nos	2			_	1:69		WEATHER: Fair, lo 60 SF, very strong wind, gusty
SAMPLE MTERVAL	SAMPLE TYPE	BLOWS / 8-NCHES	NCHES DRIVEN	NCHES RECOVERED	OVA READING (ppm)	MOSTURE	DENBITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	the south the street of the street of the street	ГІТНОСОВУ	SKETCH OF BORING LOCATION
					20230						73		MATERIAL DESCRIPTION
						51.	المرا	1041	B.				
					O	s'.	र व्य	4/3		,	Ц	1. 1 *	0.5 - 1.1 Silt, clayer, sdy,
											T		souther, st. mount, ligan
					D		selx	10 3%		l ₂	Ц	• "	
			,	,		mai	+	6/3			Ш		1.1-2.9 Sand, well sorted, fine
2.7			2.7	2.7				אצענ		7	-	2.9'	and, most, pole brown
4			,		2	عدا		103	3.2		H		2.7-32' E11-54-MW1121A @ 0832
.			8'	- 4	0			3/2		4	H	7.0	2.9-4.0 Clay, sly, mino sd.
				3				1071			H		very mark to wet at sop, wet a
								4/3		5	1		3.4, very dock granich br.
					0	N.B							mottled sold / vange on.
							sof	<u></u>		6.	Ц		4.0' - 13.8 Clay, silvy, br.
											L		mother, vrange by die gray
4			<u> </u>		٥	·				7	μ		0
A,						سب	pm		1		H		
7.7				ļ	0	A 0.4	8			1	Ц		
7			20	2.8							H		
1			<u></u>								Ц		
V										ľ			1
					_								

EDITED BY/DATE:___

NOTES:_

Halliburton NUS

FIELD LOG OF BORING

WELL NO. M W/21

SHEET 2 OF 2

N P		COR	POR/	ATIQ	<u>N</u>								0.114 BORING NO.: MW//2-1
PROJ	ECT:		EAK	R AF	B RF					JOB	No.	0.:	0 114 BORING NO.: 71 2/1
INTERVAL	SAMPLE TYPE	BLOWS / 6-WCHES	INCHES DRIVEN	RECOVERY	CVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	DENSTREATION OF THE PROPERTY OF THE PERSON O	LITH.	
											H		117' Clay, loss silk condent, is from
										71-	H		Ji. 1 Cong ; Total live : 1
						فالمسر	۲_	10 XX		,,			
4					0		gin	טור			H		
12.7		-			-		<u> </u>			, –	H		
1										14 -		13-8	13.8' - 16.3' Clay, at silve, from
T			2.6	2.6	0		gun	Vo YA		· .	H		most the gray mother of thought in
 				17.0	0	Non	_	4/1		15-	П		
4										16-	H		
163											H		
		-				-				רין	Ц		
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					1						H		
L	1	J	1	1	<u> </u>								

EDITED BY/DATE:_

FIELD LOG OF BORING

WELL NO. MW1122 SHEET 1 OF 2

-		<u>CUN</u>	TUN	ATIQ	4.1						-		200
PRO	JECT:	Ĭ.		EAK	ER /	AFB F	RFI		JOB	NO.	:	0	BORING/WELL NO.: MW1122
									LOG	GED	B	<u>Y:</u>	BOH TOTAL DEPTH OF BOREHOLE: 17.9
DRIL I	LING (CONT	RACT	OR:		Tri-S	tate	Testi	19				SURFACE ELEV.: DATUM:
DRIL	LER'S	NAM	E:	Ove	1	F Beg	ger						START TIME: 1236 DA'E: 4/7/95
DRILI	L RIG	TYPE	:			- 5	5					<u>.</u>	FINISH TIME: 1430 DATE: 4/7/95
BORI	NO M	ETHO	0:	H	SA		"				·_		WATER DEPTH:
HOLE	E DIAN	METER	1 :	7-	"								DATE:
SAM	PLING	MET	HOD:	-		<u> </u>	w						TIME:
HAM	MER	WGT.	:	N	4		DRO	HGT	: N	A		<u>'</u>	BACKFILLED, TIME: DATE:
SURF	FACE	COND	ITION	18:	بر	nos	<u>v</u>						WEATHER: Fair, upper 70°5 F, costorly sind
SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB BAMPLE NUMBER	DEPTH IN REET		LITHOLOGY .	SKETCH OF BORING LOCATION
													MATERIAL DESCRIPTION
					0	سدا		257					0.5'-1.1' Sand, fine grained, why,
0.5						0	200	4/4		١.	L	1.1	sh cloupy, Northers, which has
					^	51.	a	2.5					11'-18' Sand, his agg and, silve,
					0	משת	PR	6/4			T	1.9	sl. mist, list yellowing byen
V			23'	27				25Y		12.			18'-22' Clay mander at ton silver
_					D	200		412			r		dest marie land asset march
2.8			_							3-	+	32	The grant of the state of the s
					0						-		id sit the fig. the
			_	-		-	<u> </u>	2.5		4-	+	-	3.2-3.1 Clay, May, the state from
					D	more		51)			-		motited mange for, month
1			_		-			<u> </u>		5	-	-5-1	4.8 - 3.3 EVI -3U- MW 222 A @ 1250
			5.0	5.0		۰	sof	2.5	1				5.1-6.2 Sand, vary fine graned 75 outs
业_					0	~~	300	4/3		6	╀	1.2	other form, wat
						١,		pYA			L	متنقا	6.2 - 7.7 Clay, ily , bow, ander blooms
ADAWAY.					0	4.43		40		7.	1		orange brown moist
										ľ			7.7-9.1' Sand very fire grand, silvy,
28										8.			lista oliva from front
						مد	~Br	2.5		° ا			
					0		M) .	5/3					9.1-11.7' Clay of silv. mother lists
1.								IOTR		17`		1. ₅ ,1	Pluis now it los man he mont
~						- News		6/2			r	c in	, , , , , , , , , , , , , , , , , , , ,
	-	سيبا					-	-		-	-		

EDITED BY/DATE:__ MOTES:_

FIELD LOG OF BORING

WELL NO. MW1122

SHEET 2 OF 2

		COX	POR/										0114 BORING NO.: MW1122	1
PROJ	ECT:		EAK	RAF	B RF	1		1		JOE		0.:	0114 BORING NO.: MINITE	
INTERVAL	SAMME TYPE	BLOWS / 6-ENCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	Transferrance francisco	стн.		
-				•				3		//-	H			
4			5.0	5.0	0	دنهد	fin	2.5Y 5/2		n -	H	11:7	11.7'-17.9' Pay, st. siley, gravish box	
5.8										U -			11.7'-17.9' flow, st. silvy, grayish for norally marged by to lodget from	
						_				71-			7 0	
						_				15-				
						-				16-	H			
										17-	H		·	
										_	H			
											H			
							_	_			H			
		-			_			_	_		E			
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				_							1	<u> </u>	EDITED BY/DATE:	
NOT	E5:												EDITOU OTIVATE	

NOTES:_

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1123

		COR	POR	ATIC	<u>N</u>		**							5/ICI	·	
PRO.	ECT:			EAK	CER A	AFB F	RFI		JOB	NO.:		0	114	BORING/WELL N	o.: MW 11	23
									LOG	Œ	BY:	- Millar	TOTAL DEPTH O	F BOREHOLE:		
DRIL	TING C	ONT	RACT	OR:		Pri-S	tate	Testi	ng				SURFACE ELEV.:		DATUM;	
DRILL	LER'S	MAK	e:	Jol	21	C	ra	wf	orc	}			START TIME: 15 E	35	DATE: 8)	195
ORIL	L RIG	TYPE	: (W	٤	75	·			1			FINISH TIME: 173	30	DATE: S 11	1195
BORS	NG M	ETHO						dril	ed	WI	IN A	WATER DEPTH:				
	DIAN									,		DATE:				
	PLING				wh	<u> </u>	~U<	5 5	An	1.0	TIME:					
	MER V				NA		1	P HQ		W	BACKFILLED, TIME:		DATE			
SUR	ACE	CONE	AOTTO	16:	<u>G</u> .	ras	<i>3</i> E,	ч				WEATHER: Hoti	Humid:	950 F. S	Sunny	
GAMPLE INTERVAL	Sample type	BLOWS / 6-NCHES	MCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOGSTURE	DENSITY	RUNSEL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	ПТНОГОВУ		diteti MWHZH	ETCH OF BORING	LOCATION	To the
														MATERIAL DESCI		
3	33.3	NA	351	351	0/0	mois	51	322			S			- Sand	ish brn	coler
					12			1075	1			. 1		brn 4h		The second second
+			1	††	0/		512	1934	-	Z				at of		
				11	1%	1	130	1						yar; we		
3		-	46	23	V		H	1046	-	B	F	-			her roc	
					1/0			614) 12. 12.		cohesin			
	\vdash	+	₩-	╁╁╾	17	╁	╁┼	H	8	4	() ()	,	1.5'	less you	07 5 TO	J.0'.
				Ш	1%				12 - 12 - 12 - 12 - 12 - 12 - 12 - 12 -	5						
-			-	₩	1		Н	+-	2	þ		•	3.0' - 8.5			-
			11			1	1			la y	id T			angular		
		4	#		_		_	-		ь	Н			Henomis		
											1		root	casts T	COSTS;	mothed
			Щ.		_			1	_	77				R416 d		
1											Ц		brn;	applai	<u>a jami</u>	nated
9										5	U×	.,			· ·	
			SF	3.5	0/	591	14.24	13%			5. (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		8.0' - 9	5'-5	ic ; tr	ace
					10		11	11		6			Sand:	veg; b	ca wi	oyes/e
		1	П	IT	0/	11	\prod	\prod		ľ			Vellow	ish brn	rnoHli	ng.
		1			1/0	اعلا		7		44					C/pdp	

EDITED BY/DATE:__



FIELD LOG OF BORING

WELL NO. MW 1123

SHEET OF 3

HILBERT COOLER TO THE PRINTER HIMBER OF THE STANDARD STAN	PROJEC		FAK		1				JOB	NO.:	OII BORING NO.: MWII 23
trace VFq sond; brn Some rects: rat (lests + Worm burrows; mothled w 10483/2 yellowish brn; sit plastic 13.0' - 18.0' - CLAY: trace 3.11; grayish brn w 20 20 17 10 20 20 20 20 20 10 20 20 20 11 20 20 20 12 20 20 20 13.0' - 18.0' - CLAY: trace 3.11; grayish brn w 20 20 20 20 20 20 20	8 8					DENSITY	cotos	BAMPLE NUMBER		41.50	
		No. 4	150	100000000000000000000000000000000000000	+	つけX 	104		- C 3 7 5 17 8 9	7	trace VFg sand; bra some rocts; roct Masts + Worm burrows mottled w, 10483/6 yellowish bra; 51+ plastic 13.0'-15.0'- CLAY: trace 5:11; grayish bra w multiple root casts , worm burrows throughout; Giled w/ 2.548416 dk red silty sand material some root structures still intact; Some Chliche; 511. plastic 15.0'-19.5-CLAY: trace 5:11. Mark gray; some worm burrows / root cast but not as many as 13.0-15.0' Worm burrows filed w 2.548 416 dk red material; not plastic until ~ 19.0' when more 5:11 is noted. No worm burrows root casts below 18.0' but some chliche hoted.

NOTES:

EDITED BY/DATE:

FIELD LOG OF BORING

WELL NO. MW 1124

SHEET _____ OF ____

CORPORATION				··	
PROJECT: EAKER AFB RFI	JOB NO.:	7114	Boring/Well N	O. MWII	24
		millar	TOTAL DEPTH O	F BOREHOLE:	
DRILLING CONTRACTOR: Tri-State Testi	ng	SURFACE ELEV.:		DATUM:	
DRILLER'S NAME: John Craw	ford	START TIME:	0930	DATE: 8/12	195
ORILL RIG TYPE: CNE - 75		FINISH TIME:	1.915	DATE: 8/12	2195
BORING METHOD: 714 HSA GVEY drill	ed wio HSP	WATER DEPTH:		·	
HOLE DIAMETER: 10"	•	DATE:			
SAMPLING METHOD: CON +1 NUGUS	iamplina	TIME:			٠.
HAMMER WGT.: NA DROP HGT		BACKFILLED, TIME:		DATE:	
SURFACE CONDITIONS: Grassy		WEATHER: 1+0+;	Humid:	95°F .	SINULL
300720200000000000000000000000000000000		·	,		1
SAMPLE INTERVAL SAMPLE TYPE BLOWB / B-INCHES WCHES DRIVEN MCHES RECOVERED DVA READING (PPIN) MOISTURE MOISTURE	LAB SAMPLE NUMBER DEPTH IN FEET GROWMWERFACERS	MINIZH .	, www.	23	. HI.
NA 1 NG 1	E N.				
SAMPLE INTERVAL SAMPLE TYPE BLOWB / B-INCHES BLOWB / B-INCHES BLOWB / B-INCHES OVA READING (PPI MOISTURE DENSITY MUNSELL COLOR	LAB SAMPLE N DEPTH IN FEST SOME WINDERSELL LITHOLOGY	<i>J</i>		\	
SAMPLE SAMPLE BLOWB / NCHES I NYA REA MOISTUP MOISTUP MUNSELI	B SA PTH KOL		By Socre	ze He	\ \
SA SA SA SA SA SA SA SA SA SA SA SA SA S	2 2 5	SKE	TCH OF BORING	LOCATION	
			MATERIAL DESCR	UPTION	
3 CD NA 501 4-5 0 MOLE LOOK 314		.5- 1.5	- Clar	14 51C	Ti
10 10	ML	Some : S		anjula	
(0)	A			wish br	
/6 Lice 1/4	W 5M	ce	yene		
36	7.512	1.51 - 2.3	·		 .
% sact .375	L C			rdy sie	´ 1
 	The It	some c		4. Cohes	ive
1		vydko	rayish	brn	
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	<u>V</u> 4				
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	n gict	2,31- 2,5	<u>' - SAN</u>	ID; VEG	,
5 PPT SET O/MOG SET	-W-5	a well so	ted; and	sular;	ben.
4 1 1 7 1 7 1 (7 1	Igminat	ed w	rellow, 3h	brn.
	4	color.			
0/	2F.				
	2	2.51 - 4.51	- Claye	u silt	
1 0/ WET	0	Some m			areush
!	7.	John I			3.5'
3 60 67 94 0/		501 U	olor cho	9	
1 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		to grafi		104R4/6	ak
Amous II LAVR	ML	red mot	ilens.		
1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	04	4: M/ A /			
	14	4.5'- 9.0'-	SILT	greyis	sh brn.

NOTES: drilled to determine if contaminationeDITED BYDATE:

ec. 515 in the lower aquirer.

FIELD LOG OF BORING

WELL NO. MW1(24

SHEET ____OF ____

14		CO	RPOR	ATI	<u> </u>							
PRO	NECT	:	EAK	ER A	FB FU	FI				201	5 NO.:	DI)4 BORING NO.: UW1124
INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.	
IT	丁	11	11		%	mid	35.37	- a,				trace sand ufg; trace clay, more clay from 6.0' - to 6.3'.
		\prod			10/			\prod		12	がい	mothed throughouth wide yellowith braj from 9.0'- 9.0' more clay.
13	#	╫	SFT	50	%	SI E S	350	F	-	13		9.0' - 14.0' - SILTY CLAY
上	世				0/0		学	F 1071	-	15		roots; some intact carbonized roots; some intact carbonized root structures; grey w/ 2.542
	-	}-	-	-	6/	-	-	ightharpoonup	8173	.		4/8 dx red; plastic
10	H	-		-	%			#	ALA	17		14.0' - 18.0' - Clay ; race Sift de gray, some Vertical seams filled wil love 518 yellowish ben
			1351	9F	2/0/	- 34. - 34.	学	1	FDR	19	ACH CH	
+	H	-		-	0/0	+	+		EN	26	Ä	at N16.01
					%			I	ECT.	71 73		more werm burrows; roof casts vorticle seams filled w 10455
13			e-ox	4.5	0/0	7		\coprod	3	23	-	extends from 21.5'-22.5'. Horizonfal Yfg Sandy/Silt San
+		-	501	1	0/	-	-	igwdapprox	S	74	در	from 22.01 - 22.51:
+		 			% %		-	H	4PE	25		23.0' - 26.0' Sand (Filty CLAY) sand is med grained; angular;
1					%	SPIT	-225	OYE SH	SAMP	26 · 27		Well sorted; dk avery w/ some layers/s mothly some vary small root costs; or worm
29	HC v2		10 FT	120	0/	\prod	1		o _N		4	21 / 35 11 - 5411) - men aminud
+	-	-		+	%	+	+	#		29	SW	John 38.01 - SAND; men gminid angulan; Well sorted; 912. yellowish hm.
~	, ,	, '	, , ,	ા }	/ O	1		1 1	1	46	77	

NOTES:_

Halliburton	NUS
00000012001	

FIELD LOG OF BORING

WELL NO. MWIZY

SHEET	 OF	

MITERVAL MONSTURE MITERVAL MONSTURE MITERVAL MITERV	747			POH							~~					
MA ME COMPOSITION OF THE SAME OF THE TOP OF	PRO.															
Continued drilling wy 7 Millist to 10 of 38 - No Sending Continue Continued and the sending Cont	MTERVAL	-				1		•	T		DEPTH IN FEET	итн.	·			
Continued drilling wy 7 Millist to 10 of 38 - No Sending Continue Continued and the sending Cont		۸۸	MR	1001	אסטו	0/	597	وعمن	34							
28' - 38' - logged by Cuttings 7D - 38'				Щ		10	Щ				31		Continued drilling	W/ 7/4/1+SA.		
													to TD of 38' - No	Samplingfrom		
26	- -	-	+-	-	┝┼╸						32.		381 - 108 St	d by cuttings.		
70						96						- 1a	· · · · · · · · · · · · · · · · · · ·			
90	┝┼┤	+1		+	+					7.	53	ייכן				
90 NA 17 37 38 38 38 38 38 38 38 38 38 38 38 38 38	1					J.D				S	411		TD - 38'			
28		Π				0/			- 1		34					
90 47 30 37 39 39 39 39 39 39 39	11	\coprod	\Box	4		/0		_ _		5	35					
96 97 98 98 98 98 98 98 98	- 1					0/				J						
37	┽┤	+-{	+-1	++	+-	K		-{-	+	<u></u>	ઝહ					
37 70 90 00 00 00 00 00 00 00 00 00 00 00 00	11	11	11			90	$\parallel \parallel$		11			**				
SAMPLES GOLUECTED FOR	++	11	H	+			+1	\dashv	11	•	37					
SAMPLES GOLUECTED FOR	38	·	1			10	1			W	20					
SAMPLES GOLUECTED										24	20					
SAMPLES GOLUECTE		_						_	\dashv	F]				
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SAMPLES GO										3] [
SAMPLES			_			_			_	0						
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		1			7					一						

EDITED BY/DATE:

13038318208;#13/21

SENT BY: BROWN AND ROOT, ENV ;12-21-95 ; 4:25PM ;

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1125

SHEET ___ OF 2

	<u> </u>	UKI	OHA	_				Т				BORINGWELL NO.: MW1125
PROJE	CT:		1	EAKE	R A	FB R	FI	F .	80L			BORINGWELL NO.: AWTT23 Millar TOTAL DEPTH OF BOREHOLE: 28
										ED B		SURFACE BLEV.: DATUM:
DRILL							tate T					
DRELL							س	For	1_			
DRULL	RIG T	YPE:	<u> </u>	ME		15						
BORIA	IG ME	THO	o:7%	א ייני	SAC	Sve	<u>rdri</u>	Hed	W	10° F	15 4	WATER DEPTH:
HOLE												DATE:
SAMP	LING	METI	100:	Con	tin	برون	<u>s </u>	an	201	ng		TIME: DATE:
HAM	VIER V	vot.:		JA			DROP	HQT	<u>: </u>	JA-		BACKPILLED, IIIIL
SURF	ACE C	OND	MOIT	s: 6	<u>- 19</u>	53	u_					WEATHER: Overcost : 50's - 70's : 511. breeze
BAMPLE INTERVAL	SAMPLE TYPE	BLOWB / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	Munbell Color	LAB SAMPLE NUMBER	DEPTH IN FEET	гиногову	HUNTED ROLLEY BY SHOPETTE N SKETCH OF BORING LOCATION
70000	281 A 8 E	_		Sirma Sirma		(200		17.7	MATERIAL DESCRIPTION
	70		22	000 (No.		PX				2 4 5 88 12 12 14 18		See boring log for MWII24, drilled 3/12/95 for description of lithology from Surface to 18.0. Summary of lithology from Surface to 18.0: 0.0:-1.5'- Clayey SILT 1.5'-2.3'- Sandy SILT 2.3'-2.5'- SAND 2.5'-4.5'- Clayey SILT 4.5'-9.0'- SILT 9.0'-14.0'- SILT 14.0'-18.0'- CLAY
1	22.1		SFT	351	0/		150	92	3	20	ىن	

NOTES: Drilled to determine extent of Contamin- EDITED BYDATE:

NOTES:_

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1125

SHEET 2 OF 2

SILT, bro yellowish	- Silty CLAY; Clayey . WIOYR 5/6 brn. moHing;
CL 18.01 - 20.01	. WIOUR 5/6
SILT, bro Vellowish	. WIOUR 5/6
	brn. moming.
Some room by	or siructures and
23 25 0 10 23 CL 20.0' - 21.0'	- CLAY: trace Silt;
mothes	Some brn 1048513
0/ 6/2 25 DN 21.0'- 24.5'- gray; 50	and is prorty sorted, and some fa
sand, ar a a inch	ngular; @ 24.0° Ts verticle fand seam: Pa tomed grained
5yR 519 angwar	yellowish redand
24.5'- 25.0'- 	sand; well sorted angular; gray.
25.0'- 25.5' Sorted m 11 12 50 12 12 50 13 12 13 13 13 13 13 13 13 13 13 13 13 13 13	- SAND; Doorly 19-fg; angular re coarse grains; blosed a lains, Overall
No so so so so so so so so so so so so so	RSIO YELLOWISH
25.5'-28.0'	
TD = 25 0 14	
27 37	

EDITED BY/DATE:_

FIELD LOG OF BORING

WELL NO. MW 1126

	9	CORF	ORA	TIO	Ŋ									. (/
PROJ	ECT:		•	EAK	ER A	FB R	Fi		JOB N			114	BORING/WELL NO		22 12
									Logo	ED B	٧: G	Millar	TOTAL DEPTH D		83,0:74
DRILL	LING C	ONTE	ACTO)#: 			tate T			•		SURFACE ELEV.:		DATUM:	
DRIL	LER'S	NAME	: 5	Tor	m (() -0	w	For	<u>-d</u>				0 27	DATE: 11/01	195- aroux
DRIL	L RIG	TYPE:	C	ME	_	75						FINISH TIME: /	900	DATE: 11 67	195 grow
BORE	NG M	ЕТНО):7/ ₄	"IIS	AOV	rend	ville	du	1/1D	" H	<u>sa</u>	WATER DEPTH:			
		METER										· DATE:	·		
SAM	PLING	MET	HOD:	بردي	rtir	700	SUS	<u> </u>	m	<u>eli</u>	<u>n.s.</u>	TIME:		1	1
		WQT.:		NA			DROP			JA		BACKFILLED, TIME:		DATE:	
SUR	FACE	COND	ITION	8: <i>(</i>	Src	255	Su.					WEATHER: OVEY	cast 50's	- 60'5	
Bample interval	SAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	INCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	LITHOLOGY	MW 423	SHOODETTE		O suntal
	*****	577793		22.3	2561								MATERIAL DESC	RIPTION	
		***	20			0000				2 4 9 8 10 12 14 16 18		Acr lither Summa 0.0'-18 0.5'-1.1' 1.1'-2.9 2.9'-4.0 4.0'-13:	- Jand	CLAY	-18-0-
19	52.7	NA	SET	3.3	0/			147		20	c	1			· ub els-

NOTES: Drilled to determine presence or absence of contamination.

EDITED BYDATE: Ja Elli 11/20170

FIELD LOG OF BORING

WELL NO. MW1126

	UU	(POH	ATIC	<u> </u>				_			8HEET _ 2_ OF _ 2_
PROJECT		EAK	ER A	FB R	1				N SOL	O.;	0114 BORING NO.: MW1126
INTERVAL BAMPLE TYPE	BLOWS / 6-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	BAMPLE NUMBER	DEPTH IN FEET	LTH.	
223		\$5 T	The state of the s	000000000000000000000000000000000000000	150 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	135	-		2 2 23 24 25 26 27 25 29 30		18.0'-20.3'-CLAY; 311. Plastic alk gray; some root structure + worm burnows. 20.3'-21.3' - As above wy Color change to brn. 33.0'-25.0' - CLAY; some Sand; poorly sorted angular med; coarse, I fine graves, alk gray; Sit plastic; some root casts, worm burrows, Veins filled wy yellowish red silt; some iour 513 (brn), mottles. 25.0'-28.0'- Sand; CLAY; ak gray; anoular; fg- coarse graved; veins filled wy ieyes 12 yellowish red silt. 28.0-29.2'- Sand; CLAY as above, sand is med anaixed to fine graved. 29.2-33.0'-SiND; med anaixed to fine graved. Therest to be sand party Therest to be sand party Therest to be sand party or ball cuttines to apparent bose the party.

NOTES: DUE TO FROMINITY OF ADTACENT HOURS & TIME LIMITATIONS, EDITED BY/DATE: JRGIL 11/21/95

LOCATION

13038318208;#17/21

SENT BY: BROWN AND ROOT, ENV ;12-21-95 ; 4:27PM ;

Halliburton NUS

FIELD LOG OF BORING

WELL NO. MW1127

SHEET _____ OF _____

	9	CORF	ORA	TIO	N									
PROJ					ER A	FB R	Fl		JOB N	10.:	ζ.	>114 ·	BORING/WELL NO.: M	
"									LOGG	ED B	v: C	r. Millar	TOTAL DEPTH OF BORE	IOTE: 53.0,
DRM!	ING C	ONTE	ACTO	OR:		Tri-Si	ate Te	stin	9			SURFACE ELEV.:	DATUA	
							W						34 DA'.6:	11/02/95
	L RIIG '			Cn	1E	- 7	-5					FINISH TIME: 14	DATE:	11/08/95
BOFU	NG MI	ETHO					rdri	Nec	W	10"	HS/4	WATER DEPTH:		·
	DIAN											DATE:		
					tir	וטפו	us :	Sai	<u>~p</u>	lin	9	TIME:		
	MER \			NA			DROP	HGT	: 1	AL		BACKFILLED, TIME:	DATE:	
SURI	FACE (COND	ITION	5 :	Gr	a s	su					WEATHER: OVEY CO	ast; breezy:	10.5-50.5
SAMPLE INTERVAL	SAMPLE TYPE	BLOWS / B-NCHES	NCHES DRIVEN	NCHES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB SAMPLE NUMBER	DEPTH IN FEET	итносоах] ₁)	MWIIZT OF BORING LOCAT	*(
700		72633	18228		123183	35-24-2	0.750	1 (2)	93		450	2	MATERIAL DESCRIPTION	
												See borin	109 for	MWIII 6
	\downarrow									2		drilled 12	licks for 1:	Hology
	17	-										from 180m	surface +	0 18.01.
	1	P ₂								4				
		1								l' l				
		"	2											
			X	b										
			10%	150							П			
	1	-	 `	D.	Φ					٦	П			
		1		14	1							·		
_	+	_	1		忿	D				(°)	Ħ		•	
					2	1/7					Н			
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							(8)				H			
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	-					1 .		1,0	}		H			
-	+-	┼	-	┼	+-	+-	 		+	16	H			
				1					1		H			
13	105	NA.	SFT	58	Upp	477	37.91	(ye	 	18	쌀	18 01 10 0	1 6:14.0.	ALL Clause
11	525	41				SIT:	317	gya					'-silty ch whiple sno	= 11 500t
11	11		1/	1.1	11	Jane S	ليبنج لا	7	1	20	P	1 3161 M	whole so	arrour

NOTES: Drilled to determine the absence or presence EDITED BYIDATE: # EDITED BYIDATE: # EDITED BYIDATE: # SUP.

FIELD LOG OF BORING

WELLNO. MW1127

SHEET 2 OF 2

MAN. CORPORATION 0114 BORING NO .: MW1127 JOB NO .: EAKER AFB RFI PROJECT: BLOWS / 6-INCHES BAMPLE'NUMBER INCHES DRIVEN DEPTH IN FEET **SAMPLE TYPE** OVA Ippm) RECOVERY MOISTURE MTERVAL DENSITY COLOR Ë. 200 structures Iworm burrows ک WIL filled WI SUR 518 yellowish red material Inveral Color brn. حد 22 9.0'- 24.5' - CLAY some **73** SET 3.8 SILT · root structures / Worm burrows to 21.0' then less root structures but some IGURSIZ brn. mottles, Some fg-mg, poorly sorted sand. 5W overall color dk gray 앩 24.5'- 26.0' - SAND, Yfg-fg. SP Well sorted; angular, dis gray Peat-like material from 23 25.0' - 25.2' dk black 26.0'-29.0' - Vfa - ma SAND Welterm. poorly Sorted, brn. Pos. angular grains 9+z. TD = 23.0 36.5 SPY 33

NOTES: DUE TO PROXIMITY OF HOLES & TIME LIMITATIONS

This LOCATION.

EDITED BY/DATE: JRGILLA

FIELD LOG OF BORING

WELL NO. MW1128

SHEET ___ OF _3

	CORPORATION POPULATION AND AND AND AND AND AND AND AND AND AN																		
PROJ	ROJECT: EAKER AFB RFI JOB NO.: LOGGED BY:												3114	BORINGWELL NO .: MW1128					
									LOGG	ED	BY	: (- Millar	TOTAL DEPTH O	F BOREHO	LE: ~	10.01		
DRILL	JNG (ONT	RACT	OR:		Tri-S	tate •	Testir	ng				SURFACE ELEV.:		DATUM:				
DRILL	er's	NAM	E: J	Tob	ים	<u>C:-0</u>	w	for	<u>-d</u>					<u> </u>	DATE:	11/1	23/95		
DRIL													FINISH TIME:	800	DATE:	11/9	55/95		
BORI	NG M	ETHO	D: 7	14"	HSA	dr	ile	14 k	ros	رود	~		WATER DEPTH:						
HOLE	ORING METHOD: 714" HSA drilled through SLW Face Casing. OLE DIAMETER: 12" +0 25": 714" +0 +0.0"												DATE:						
SAM	SAMPLING METHOD: Continuous Sampling												TIME:						
HAM	HAMMER WGT.: NA DROP HGT: NA												BACKFILLED, TIME:		DATE:				
SURF						ha]+						WEATHER: Clear	; sunny;	bre	241	42°F		
					ا	1,0					H				DAWII.	-	` <u></u>		
				ല	E				18EP		THE		,58113	5	7				
VAL		HES	z	ÆRE	dd) ı			HO.	KON	 			Juil _	- BX	بعسك	/	GUW1126		
E	YPE	-INC	RIVE	CO	DNIC	w		อี	PLE	끮		<u>></u>	1.12	1/	3		(GMWIZI		
<u>\$</u>	1E T	9 / S	S	13 RI	REAL	TUR	Ţ	SELL	SAM	₹		ğ.	M Ex		-		•		
BAMPLE INTERVAL	SAMPLE TYPE	BLOWS / 6-INCHES	nches driven	NCKES RECOVERED	OVA READING (ppm)	MOISTURE	DENSITY	MUNSELL COLOR	LAB GAMPLE NUMBER	DEPTH IN FEET	Market State	LITHOLOGY	/è			.,			
/9	3	_	_	_				_			14.		SKETCH OF BORING LOCATION MATERIAL DESCRIPTION						
	112			1 2011		× 1 - 1			2944	2000	TT	3270/3				L <	amald		
											Н		Surface for Lithol	TO 10.0	<u>ري م</u>	5811	35		
										ŀ	Н		for soil de	cognia	-that		eng/		
	T										H		for Soil de	SCALP (1900)					
										2	H								
		1.									Н								
		1	Ż							3	Ц								
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		1		1	96					1	Н								
					ج	12			-	4	Н								
						7	2				Н								
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NOTES: Drilled to determine presence or EDITED BYDATE: Hale 11/28/95 absence of contamination in the Sand aquifer.

FIELD LOG OF BORING

WELL NO. MW1128

Halliburton NUS CORPORATION

SHEET 2 OF 3

	CORPORATION ROJECT: EAKER AFB RFI							JOE	3 NO.:	0114 BORING NO.: MWIIZ8		
ROJ	ECT:	S:	EAK	ER A	CB RI	<u> </u>	П		œ			
INTERVAL	SAMPLE TYPE	BLOWS / B-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppml	MOISTURE	DENSITY	COLOR	SAMPLE NUMBER	DEPTH IN FEET	LITH.) · · · · · · · · · · · · · · · · · · ·
,o 	5.2.5 5.5.6 5.5.6	NA	397	3FT	104	ALO	504	134		,,	٨L	10,0'-11.0' - Clayey SILT, brownish gray, mothedwy
					400							104R513 brn. motties.
H	-		-		18/	+				12	7	11.0'- 12.5' - CLAY; some silt;
3	+-		g≓T	557		_	ड्राप्स	33	_	13		brownish gray wisome love 5/10 yellowish bring mottles
					70/					14		Some root casts worm
					2%						2	intact; sit plastic
	+				29/					اڪا	CH	
	+-1				15		-	-		16	4 45	plastic; brn. mothed wi
					2/5		Ц_	110.10		13		10 yr 5/6 yellowish brn.
					5/			11/1		18		Some darker mottles, some
3			5FT	4.5		WE	32					intact roots.
					10	+				19		17.0' - 25.0' - CLAY, some Silt
				1	10/4					70	Ą	dk gray, crumbly texture,
					35/5	mo				4	1	verticle root casts wiroots
1	++	+			%					4	41	inches in length; Along
Н		- -	-H							22	•	(iron) staining some love
3				,	59					23		513 brn mottles; Product
3			2F1	,5	19		Π					from 18.5' to 21.2'. Sheen
H	+		\dashv							24		also noted along barrell;
5	$\bot \bot$	- -	3FT	उटा	_	1	H-		-	త	I .	Strong odor.
				1	0/0	ŀ				74	ď	25.0' - 28.0 - CLAL : Q5
П		·			%							above.
H			+	+-	0/	+	+			R		28.0' - TD - SAND: Fg-med
8	빘				/,0	-	報	1218		25	444	grained poorly to led wy angular 9tz; multi color
[7	12	SA	4	D.	<u>و</u>				24	55	grains (witt, blk, cosal); overa
1											S~	
	s:	1	لـــــ						<u> </u>	30	لسسلا	EDITED BY DATE: FLESS 11/28/15

13038318208;#21/21



FIELD LOG OF BORING

WELL NO. MW1128

SHEET 3 OF 3

N D		ÇQR	POR.	ATIO	<u>N</u>					_	_		0.174	BORING NO .: MW1128
PROJ	ECT:		EAK	ER A	B RF	1	,			JOB NO.:			0114	BOWING NOT 12 CAN LES
INTERVAL	SAMPLE TYPE	BLOWS / 8-INCHES	INCHES DRIVEN	RECOVERY	OVA (ppm)	MOISTURE	DENSITY	COLOR	BAMPLE NUMBER	DEPTH IN FEET	Secretary of the second second	LITH.		
	awas 10	10	INCHE		-		DENS			133 37 35 36 37 4c		HUT TO THE TOTAL	TD = 40.0'	

EDITED BY/DATE:_ NOTES:_

Holo No. AP-62

DRILL	NG LOG		1810H 1RD	INSTALL	111:14			OF 2 SHEET
. PROJECT				10. SIZE	AND TYPE	OF BIT	1014 hit	
ARIISTA LOCATION	Olive :	TUBY	LEAKER AFB AR.	III. DATU	M FOR EL	EVATION	SHOWN (TBM or MSI.	,
	5' fr	on L	1F62				NATION OF DRILL	
USACE	GENCY - C & I - I	r.K-e	P-66-		E 750			UNDISTURBED
HOLE NO. (4		a titla	BURG	L NO. OF	ES TAKE	н	
NAME OF C	RILLER	EVOR	(b A) 02		L HUMBE			
ROGE	R HU	NTER		15. ELEV	ATION GR		7	COUNTEL'EL
DIRECTION			DEG. FROM VERT.	IS. DATE	HOLE) OCT 95
<u> </u>				17. ELEV	ATION TO	P OF HOL	.E	
. THICKNES				1			FOR BORING	
, TOTAL DÈ			10.7		ATURE OF O大りい			
ELEVATION	DEPTH L	FGEND	CLASSIFICATION OF MATERIA	LS	% CORE RECOV- ERY	BOX OR	REM/	RKS
. LEVATION	6	e c	(Description)		ERY	NO.	(Drilling time, wa weathering, etc.	, if algnificant)
			· · · · · · · · · · · · · · · · · · ·				64" ID A	USER
	3							
	-						Augera	thru
ļ	크						Asplia	i e No sample
Í	14						4111 -	No sample
1	ヸ		EANLLY, Claye	/				
1	=		Gill	,				
	Ξ		41/ gravel				SET U	P REJECT
1	, =		dr. gray to b	301			÷0 2	311F From
	-=		petroleum ad		ĺ		3-25-	95
	3		FE (19 K SIII SI					
	\dashv							
1	=							
	3_	-		<u>3.0</u>]			
	\exists		C	/				
1	_=		SILTY LENIICA	Δγ			inserled	INITE
	\exists		damp - moist					mpler-
	, =		mollind army &				1	•
	4-		orange.			1.2	Kan Rec	2,8
ļ	\exists	-	V. STIFF		ļ	GEOTECH FIELD T		fell out of
	\dashv	-	medium to stiff		1	4.5	l .	hre
	コ		petroleum odor			4.5	٥,	n 12
	5_		,			į.		
	3	-	h					
			becomes sandy		l			
	⇉		and moist to we	t		1		5,8
	<i>,</i> , ∃		permeum ador	(heavy)	1	ĺ	P.al	
i	\equiv		Stiff	6.2	ļ	1	Push pro	
	\exists	•		/ /	1		Singer.	5'
	-=		SILTYCLAY to clay.				Rec.	4.9
	ㅋ		V.STIFF TO STI	FF (bre	KS W/	pressure		• • •
	7-7		Cohesive			1	made me	ascrenents
	\exists		gray & orange	· hum	اا		from ou	gered dept
			(dk brown are	c vibon	Τ΄	7.4 Sumple	of 108'	; one fer
			(dK brown ares cut w/ Knife- almost a sheel	100824	Smelk	like p	troleum pro	educt)
	" =	_	viimost a sheep	1.9		7.8	,, ,	
	/-		> 1 LT		1	"	01, 01	LAIC 97 DIELLI
	=		DAKK GPAY; Wet	to	1		made from	om tipo
	그		SATURATED, medi	um		0	probe;	
	\vdash		Petro leum odor	E		8:1	1	
	93		Petto teum odor			sample	10.0 on	augor =
		-	SILTY CLAY	/	9.2	9.0	10.1 on	probe
	_	: 	STIFF HOIST		}	9.5	1	
] =		GPAY 4. Orange br.	29161		sample	•	
	110 =		I roh redukt			9.9	1	

						Hole No.	AP-62	
DRILL	ING LOG	DIVISION MRD	INSTALL	ATION MPK			OF Z SHEETS	
L PROJECT	L		10 517 5	AND TYPE	OF BIT	SHOWN (TBM or MSL	,	
A LOCATION	trong St (Coordinates or RFB	tudy EAKER AFB	1					
S DRILLING	AGENCY		12. MAH	E 75(R'S DESIG	NATION OF DRILL		
USACE	-CEIMPK-	- EP-GG	13. TOT	AL NO. OF DEN SAMPL	OVER- ES TAKE	DISTURBED	UNDISTURBED	
		AP-62		AL HUMBEI				
ROGE	P HUNTER	2	IS. ELE	VATION GR		10	OMPLETED	
& DIRECTIO	N OF HOLE		16. DAT	E HOLE	12	OCT 95	18 OCT 95	
T	S OF OVERBUR			VATION TO				
	RILLED INTO RO		19. SIGN	ATURE OF	INSPECT	FOR BORING		
9. TOTAL DE	PTH OF HOLE			Atles		ldin REMA	IRKS	
ELEVATION	1		ALS	S CORE RECOV- ERY	SAMPLE NO.	(Drilling time, was weathering, etc.	ter lose, depth of , if significant)	
•		SILTY CLAY		<u> </u>				E
	=	(continued)			10.5			E
		(55,				TRPH		E
	l,, 			<u>-</u>	10.7	T		E
1	"-=					B. O. H	@ 10.7	<u></u>
	=						11.28 >	È
1								F .
	12			İ				F
1	1 =			1	ļ			E
								E
	,			Ì	1			E
	13.					\ \	13.33	=
					-	\Y		E
							1343	F
	1., =				[E
	14-					_		E
	=					Taped	hole to	E
	1 =					10.3 ' a	Her augers	E
1	[[]					Norre		E
Į	15-					MAY HAY	ve To all depths	E
	🖹					UP 0.1	/ Sapins	E
ĺ						J		F
],, =				1	Samuelar		E
	16-				1	4.2 -4.5	FIELD TRAH	E
	=					7.4-7.8	(TPH, TRPH)	E * -
	日目					8.7 - 9.0	TRPHTE PAH	E
	1,, =					10.6-10	8 FIELD TRP	'E
								E
1	=					No wate	er in hole	E
ł	寸					nn 200	oct; hole	=
	,,]					harre	ned with	E
ļ	18					Concrete		F
1	E					CONCIETE	•	E
İ	1 =							F
	[]							E
	19-							E
	=							E 1000 000 000 000
	=							E
	LO E				}			E
				PROJEC	T	, ,-,	HOLE NO.	-

Hole No. AP-67

			•				Hole No. AP-67	
		DIVIS		INSTALLA			SHEET / OF / SHEETS	
DRILLI	NG LOG		MRD	10 CITE A	PK ND TYPE	OF BIT I	Walker bit 6" inner	1
PROJECT ARIASTRI	01)& VA	LID.	STUCY	11. DAYU	FOR EL	EVATION)	HOWH (THE & MSL) bb sample;	ŀ
LOCATION (Coordinates	or Statio	on)	12 HAND	FACTURE	R'S DESIG	NATION OF DRILL	}
EAKER DRILLING A	GENCY			CME	750	/SCAF	25	1
/EMDV	- ED - (.G				OVER-	DISTURBED UNDISTURBED	1
HOLE NO. (As shown on	drawins	AP-67			CORE BO	<u> </u>	1
HAME OF D	RILLER					OUND WAT		1
ROGER	OF HOID	TEX		 		LETAF	TED COMPLETED	1
DIRECTION		LINED_	DEG. FROM VERT.	16. DATE			OCT 95 19 OCT 95	4
THICKNESS						P OF HOL		1
DEPTH DRI				19. SIGNA	TURE OF	INSPECT	FOR BORING %	1
TOTAL DE			816	K	13111	() داستورا	Judan J	4
	DEPTH LE		CLASSIFICATION OF MATERI (Description)	ALS	% CORE RECOV- ERY	BOX OR	REMARKS (Drilling time, water lose, depth of weathering, etc., if eignificant)	
LEVATION	b b		f ∾eecs for con		ERY	NO.	weathering, etc., it eigniticand	1
-								F
	⇉					ļ	6"9" ID Hollow)	F
Ì	크	.					STELL RUGERS	F
Ì	コ	1					JIEIN RUBEIN	F
ļ	, \exists		No sample thru					F
	' =	1	fill material			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		F
	3		till Marchial			İ		E
ļ	\exists						NS	E
	= =						ı	F
	Z				l			F
	1	İ			 		Ţ	F
	_=	İ				1		F
1	3	}			j			E
],]			3.0				E
	그	ŀ			1	1		E
	=		SALIDY FILL					E
			fine sand domp	0			1 1	þ
	=		moist, loose ton to black			3.8	3,8	
	₄		ton to black	ints at	base	3.9	1	F
	'=		} wet; some blk fragi	1°4.Z	<u>.</u>].	SATIRE	4.2	F
	3		SILTY CLAY dark green gray nioist		1	}	11: _:	E
	크		moist green gray	n d		45	1 .	Ŀ
		_	med-stt	4.8			AUGER 5.0	þ
	5-7		SILTY CLAY		1		1	þ
	=		gray & orange b	rourn	1	5.3	REC 5.0	
			stf to vistf			SAINPI	<u> </u>	-
	l 3		some f. sand		-	5.5		ŀ
	1,3		In moist			SALIFI	5.8	F
	6-		Some iron nadule	ی.		1	6.0	ŀ
	=		become more .	orano c	biana	n		-
			<u>V</u>	1				
	1 =		becomes grayer			6.8	.l mad-	
	17 =		1 -1"	7.0		SAMA	made measurements	ŀ
	1'=		Silty clay			7.0	" MEASUR MENTS	
	7					1	from bottom	
	1		vistiff, grange	مرين درم	1	ļ .	υρ	
	1 3		hith G	רנייטין:	1	7.9		
	183		with fine sand	 -	1	54 161		1
	F		domb to wrotz.	8.3	.	ויוו מכ	المد	
	1 3		012.11.614		- -	8.3	-	
	-]		clayey silt				- Japan 108.6	
	3		green gray	/	/		B.O.H @ 8,6	
	9 3		moist to we	//		-		
1	'		1				on 20 OCT HOLE TAP	C 3
	=				1		To 7.9', no fluid encountered. Hole	-
1	=						backfilled w/	ı
1		١	1		1	1	Concrete	ļ
1	10 =	1	1			1	Concrete	

Holo No. AP-63 SHEET DIVISION MRD DRILLING LOG 111.K 10. SIZE AND TYPE OF BIT 101/4" QUEET 11. DATUM FOR ELEVATION SHOWN (TBM or MSL) 101/4" auger bit ARMSTROLLG- VALIDATION - LAKEY (FB LOCATION (Coordinates or Station) 12. MANUFACTURER'S DESIGNATION OF DAILL
CHE-750 / SCAPS & 6 INNER by
TOTAL NO. OF OVER- DISTURBED UNDISTURB DRILLING AGENCY CEITRK-ET-66 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN L. HOLE NO. (As shown on drawing title and tile number) DUER CORE AP-63 14. TOTAL NUMBER CORE BOXES NAME OF DRILLER 15. ELEVATION GROUND WATER NOT EI)COUNTERED ROGER Hunter 18 NOT 95 STARTED . DIRECTION OF HOLE 16. DATE HOLE 18 OCT 95 VERTICAL DINCLINED 17. ELEVATION TOP OF HOLE 7. THICKNESS OF OVERBURDEN 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR . DEPTH DRILLED INTO ROCK KOTILINI. S. TOTAL DEPTH OF HOLE S CORE BOX OR RECOV- SAMPLE NO. REMARKS CLASSIFICATION OF MATERIALS (Description) (Drilling time, water loss, depth of weathering, etc., if significant) ELEVATION DEPTH LEGEND Auger to 3.8' SANDY FILL petroleum odor STAFT W/TIP OF PROCE AT 3.77 (3.8')SILTY CLAY PUSH PROBE, AUGER 5.0 dk green gray to Rec 4,Z 5.0 MOIST - wet petroleum odor 5.3 high angle sand layer bir material; only appearance of to, a bottom -SILTY CLAY petroleum odor gray & orange brown (throughout sample) STIFF - VSTIFF MOIST \$ SANL 0.07 looks like 0,21 blk at bottom blk my be flat pa rticula CAIR hole niezzured to T SAND 8.7 ; made SILTY CLLY to Iron ho dules Orange brown & gray Moist, STIFF - VISTIFF 7.Z _.7,5 measurements from bottom up 7.9. BAND 0.07 LOOKS LIKE 0.2' 7.1 black at bottom contact clayey silt dk greenish gray E DH wet medium - soft Probe 1.10 below sample some fine sand No Liquid III HOLE P LID OF DAY, SEOUT 1.1' at end of 20 OCT; 10

backfilled w concrete

Hola Ho. AD-103

			VISION	INSTALL	ATION		11014 113.	SHEET /		
OBO LECT	ING LOG		MľĎ			OF BIT	101/4" BIT 9	OF Z SHEETS		
ADLICT	20116	VALI	D STUDY - EAKER	11. DATU	IN FOR EL	EVATION :	SHOWN (TBM or MSL)		
LOCATION A AKER DRILLING A MKK-	AF K	AP	(10n) '	1	_	R'S DESIG	NATION OF DRILL			
MKK-	EP-5	G		CME		OVER-	DISTURBED	UNDISTURBED		
HOLE NO. ((As shown	on drawin	AD-63			OVER- LES TAKEN		<u> </u>		
HAME OF D	RILLER					R CORE BO		KOJITI PLL		
KO661) . () /			I6. DATI		(ST AR	TED IC	OMPLETED		
VERTIC	AL DIN	CLINED	DEG. FROM VERY	·		OP OF HOL		20 OCT 95		
THICKNESS	OF OVER	RBURDEN					FOR BORING	3		
DEPTH DR						INSPECTO				
TOTAL DE			13,6			BOX OR SAMPLE NO.	REMA	RKS		
LEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERI (Description)		ERY	NO.	(Drilling time, wa weathering, etc.	, if elgnificent		
							<i>X</i>	•	E	
1	\exists					1 1			F	1,41
l	뒥				1	1			E	• •
	. 3]				E	
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			1		1				E	
	=		(Fill)						E	
	\exists		•				1		F	
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	\exists				1	1			上	
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	2 =								E	
	=				ļ				F	
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i	\exists				1	4.0		4.0		
	⁴ ऱ_		block clay	- 4.2	-	71.0)		F	
		•	SAND		1	4.4	Kun	1	E	:
	-=		wet w/ product fine sand		1		1011 0 1.4	inver bbl	E	**
	\exists		black, cohesive				Sarais	INTER DEL	E	• .
	5_	5,0					Soingle	•	F	
	=		SAND		5.2	5.2			E	
			Acilom Expiney m/	Plac K		5.3	REC 4.	ر ها د	E	
		5.7_		5.7	_				F	
	1, =		\$11.77.4	- A. 15					E	
	"=		SILTY CLAY AND						E	
	=		high angle to ver	191		ک، ما			F	
			clay is gray a ore	anqe		DINGLAS			F	
	=		V. STIFE TO HOE.	D,		SAMPLE			E	
	7-	74.	has some root h			7/.0			=	
	=		CLLY becomes SOFTER				FIELDTRPHO	iff jule	F	
		7.5.				7.5			E	
	=	}							E	
	8=	}							E	
	"=	1				8.4			F	
	=	1				0.7	FIELD TP.P	M X 8	F	:
	-	1	CLY SILT & sand			8.6	100 SANO	8.6	·Ε	
	=	}	GREEIJ GRAY COHESIVE, Some	<i>c</i> .		1.0	100 E.H		E	
	10	4	COHESIVE, Some	t sand		1 .	ine black	k clay	-	
	1 7	4	finite in							
	=	1	adjacent la fir	ıe		9.4	Run	2.	F	
			adjacent to fir sand; tan, 1005	1 <		SILT	Run	2	E	
			adjacent to fir	ne e	nd		Run	2		

Hole No. AD-63

		,				Hole No.	AD-63	
		VISION	INSTALL.				SHEET Z	
DRILL	ING LOG	MRJ)	IO. SIZE	AND TYPE	OF BIT			
Arms		DATION & TULY	11. DATU	M FOR EL	EVATION S	HOWN (TBM or MS	L)	
L EAKE	Coordinates or Sta	I R			R'S DESIG	NATION OF DRILL	•	[
2 DRILLING	AGENCY	-66		E 750	OVER- ES TAKEN	DISTURBED	UNDISTURBED	1
4. HOLE NO.	MRK-EP (As shown on drawt	AD-63					<u> </u>	ł
S. HAME OF	DRILLER	1 1			CORE BO			1
KOGE	TC HUNTER		16. DATE	HOLE	STAR		COMPLETED	1
	CAL INCLINED	DEG. FROM VERT.			P OF HOL	00:795 <u>:</u> E	20001 12	1
7. THICKNES	S OF OVERBURDE	N	18. TOT	AL CORE F	ECOVERY	FOR BORING	*	1
	RILLED INTO ROCK		19. SIGN	ATURE OF	INSPECT	8. Juni		
—	EPTH OF HOLE	CLASSIFICATION OF MATERIA			BOX OR SAMPLE NO.	REV	IARKS	1
1	DEPTH LEGEND	CLASSIFICATION OF MATERIA (Description)		ERY	NO.	weathering, et	eter loss, depth of c., if significant)	L
<u> </u>	106	STIFF CLAY		10.1		Run 2	_	F
1	1 72	SILTY, Iron nod (s	moll)			RAN S	_	E
	I ——	sat > wet, Haray green	d oraw	e10.6				E
	111 Daes	SAND + SILTY CL		1		REC 5	>	F
	1"-7- "	sand & Cloy are side	by sid	۴				E
1	1	SAND is stained w/ bla	ck					E
	- 2 L-	Predominanty green gas	ATURAT	ED	40 h.a	ماده		F:
ł	PUT CONTA	STIFF - V.STF, WE	L () 2011,	11.9	المراجع المراجع	מיני		Ε.
1	12-1- \$			T	120			E
		FAT CLAY/FIN	ie sand	1	12,4			F
1	│ ∃⋼ [⋡]	STICKLY		1	12 14			E
	그 호 ㄱ	Some s'itt gray w/orang	e brown	,	1			E
	1, 7 7 5 5	petroleum och	2			1		F
	13-13	black hair like Iron nodules (onagoni Ulaine	1 or 100	MOLTE			E
	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	FINE SAUD - S.	•	1			13.6	E
	-	Petrokum odo	,	/===	-			-E
] '	turns green w		A			B.O.H	E
	1 =	dry; loose		/\			•	F
	1 3	adjacent to	CPAI	1	1			F
	1 = 3	clay becomes more orange	haum			A		E
ł	=	w/depth				NOTE: SA		F
	1 = 3				1	GREENIS		E
	=			i		drying;	alors	E
					İ	Vertical	y high .	F
1	1 3				1	angle p	ethusips.	E
1				1	1	1.00	1 -	E
	1 =							
				1	Ì	Free pro	duct	E
1						Free pro	hole -	E
ſ		İ		1		approx	imalely	E
1				1		3010	lend of	E
				1		day.	Hole	E
	1 =					439.		F
	1 3					backh	lled with	F
	1 = 1					Concre	lc.	E
							mple sent	E
	=					10(138	for fuel	F
	=					1	101 1421	E
						ID.		F
}								E
	EI							F
}	1 3	1				1		F

Holo No. AD-68

							Hole No.	AD-68		
DRILL	ING LOG	DIV	1510H M1 ⁵ [INSTALL	11FK			OF SHEETS		
ACHSTT:	0116 V	RLIDA	TIOI) EAKET AFB	10. SIZE	AND TYPE	OF BIT	10 14 "auger B	1+		
EAKLY	Coordinate 2 AFL	a or State	- GAS STATION	12. MANU	FACTURE	R'S DESIG	NATION OF DRILL	1		
DRU LING	AGENCY			(, f	11- 75 L NO. OF	OVER-	1014".ID HOL	UNDISTURBED		
HOLE HO. (
. NAME OF E	RILLER		7.7 00			CORE BO	TER NOT ENC	CHISTITINUO.		
ROGER.				16. DATE		STAR	ITED ICO	OMPLETED		
VERTIC	AL DIN	CLINED	DEG. FROM VERT.			P OF HOL		.O (101 1/2)		
. THICKNES								x		
. TOTAL DE			8.6	19. SIGH	WALL OF	INSPECTO	ORO LAIN			
ELEVATION			CLASSIFICATION OF MATERI			BOX OR SAMPLE NO.	REMAI (Dellling time, water weathering, etc.,	RKS er loss, depth of If significant)		
•		د ا	<u>d</u>		•	- 1	<u> </u>		_	
}	=	160					`	:		
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	3 = =		/ 	1	1				E	
	173		/ SONDY CLAY	i					F	
			/ SONDY CLAY / Crumbly textur petroleum odo	K 1	1		7	3.6	E	
	=	3.7	dk baown to bil	۱ ک	3.7	2.4	bil thin		E	
	I , \exists		VETIFF TO STIF	F , .maist	1	ANALYT		•	F	
	4၂					4.0	KAN KAN		E	
	=	-	hecames mall			ALS	REC	らら	F	
	日		becomes mottled w	1 orana 1 ahler	in co	12 a	nd		E	
	1, 4		V.STIEF, Crumb	Ψ.	1	AIKLYI	ILLL		E	
	5-	-	Surviva de la constante de la	5.0	-				F	
	=		SILTY CLAY TO CLY	SILT					F	
	=		medium moist w/wet sur				50,00	DOLYTICAL SOLVIE	E	
			white root hairs	•	5.8	5.8			E	
	163	_	Crumbly structur	e /		GEOTECH SAHIPLE	U.O-U.S (?)	F	• .
			\		1	6.1	1		E	
	ΙΞ	6.5 1	SILT W/CL some fine so	and, dr	Gray	1	.[E	
			medium we	t tosa	+ '	VIIETA	TICAL		E	
	, =		> mottled w/increase	ie 1		7.0			E	
	' 日		in clay	7.2	·	7.2	1		F	
	=		green gray, sdy, med.	maist		GEOTEC SOI ALK	<u>2</u> {		F	
	=		green gray, sdy, med,		6	7.6		LLYTKAL SAMPLE	E	
	1, 3	7.9	SILT CLAVEY	raol The	νļs	1 '''			E	
	8-		darker aray	mes					F	
	=		becomes sandy				1		E	
						.	tap	e to 8.6	F	• • •
					-		<i>t</i> , o.		E	
	9-						0,0.	1:	_	
	' =						1		E	
	=	}					No WATER	_	E	
1	1 =	1					@ end of		F	
1	1 -						11 11 (-11)	w/ Concrete	_	
	10 =	1			_L	_L_	backfilled	HOLE HO.	上。	

Hole No. AP-67

						Hole No.	AP-69	
DPU I	ING LOG	DIVISION MRE	INSTALL	TION M	P.K		SHEET / OF / SHEETS	
I, PROJECT			10. SIZE	ND TYPE	OF BIT	074 auger bit	10" inner bul	ı
ArmsTe	(Coordinates or S	I EAKER AID, AF.	1					
			12. MANU	FACTURE	R'S DESIGI	ATION OF DRILL		
1 1/2 4 /	. r . r . r . r . r . r	-ED-612.			OVER-	DISTURBED	UNDISTURBED	į
and file num	(As shown on dra nbed) OVERC	Wing title AP. 168			CORE BO	XES		İ
S. NAME OF	DRILLER OBER HUNT	EP.			OUND WAT	ER NOT EXX	COUNTER.ED	İ
6. DIRECTIO	N OF HOLE		16. DATE	HOLE	19		MPLETED 9 0:7 95	
	CAL DINCLINI			ATION TO	P OF HOL	E		
	S OF OVERBURE		18. TOT	L CORE F	ECOVERY	FOR BORING		
	PTH OF HOLE	101	1 3 7	<i>را ټر</i> و _،	INSPECTA			Į
ELEVATION	DEPTH LEGER	CLASSIFICATION OF MATERI	ALS	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMAR (Drilling time, wetch weathering, etc.,	er loss, depth of	
	b c			•	7			F
						No fluid in	١	F
	=					20 OCT; b	ofton	
						hole kac	Kfilled 1	E
	, =					[w/concre	rte]	F
Ì	' =					NoTC:		E
2	=	\				NOTE; USE		F
		Mo Sample				AHE IN-de		E
	, =	1 1				mente for		E
	-=	1		ļ		bottom up	? .	F
1	1 3	\				window u	-	E
						below sh		F
1	l a 🗏		. 2. <u>9</u>		:	re moved		E
İ	1 2-4	DAMO, FILLE, GRAY to	black.			inle.		F
İ	l E l	Fill	3.4			P.E.C.	, 9	E
	=	SILTY CLAY		١,		23.4	1. 1	F
	I . 🗏	STIFF, DAMP	to mois	+	į			E
ĺ	14-	DAFY GPAY	4,3	2				E
1	1 3	CLAYEY SILT		1	1			E
	1 =	medium, col	PS11.45			<u> </u>	pe to 4.8	E
	=	MOIST				: "	5.0	丰
	5	DARY GREEN G	PRY					E
	=	SOFT IPAI STAILED	5,5					F
1	-	SUTY CLAY				INSEPTED FI	FOBE, tip	E
	=	SILTY CLAY			FILL TE	at 5.5	pushed	þ
1	16-3	V.STIFF			6.17	at 5.5,	Gnishes	E
	=	LEGRAY + orang	ge brown	,	6.5	1	about 0.3'	F
	1	Some IRON ST,	6:17:41		10.5	below sk		E
1	=	4 iron noduli	7.0		-	REC		F
	17-3	CLYSILT		-	1	7.0	1.1	E
	=	WILE SAND COURSE	رو اس					F
		Greenich any 1/ 30		,		FIEL TER	-! i	E
		MOIST STIFF - VS			-1.8	1 FAIL	Sett Si	E
	8-	STIFF , 1101ST			} <u>-</u>	4.00	•	þ
Į	3	gray w/ or enge	אנייסחל יה	-		8,2		E
		mottles	T.:	<u>-</u>	4.5	(probe m	such yes	þ
1]	CLAYRY SILT	arau		8,8	Slipped	when hole	١Ē
	193	cohesive, greenish	, 7. ex		1	rentoua	I tram hale	/ E
	=	> becomes saturated,	medien	7 ;	1		0 4	F
	1 =				7.5	, Oi.bc	9.9	E
1	1. =				FIELD	Profess		‡
	10 =	В.О.Н		PROIE	9.8		,, HOLE NO.	<u>_</u>
ENC FOR	111			STONE	· , , , ,	111. 0.1.1	· · · · · · · · · · · · · · · · · · ·	≺

APPENDIX B - 1B

WELL INSTALLATION LOGS

BX SHOPPETTE

Source: Halliburton NUS 1992 and 1995.



FIELD WELL COMPLETION	FORM TWILDI	CHRISTY BOX
NAME: EAKER AFB	BX SHOPETTE	☐ LOCKING STEEL COVER
NUMBER: 31498	PROJECT WANAGER: CV (INCH DIAMETER
00000	701770	CASING
WELL SILL	DATE:	CM INCH DIAMETER
DRILLING A O	12/11/91	
EQUIPMENT: 1 W. POO		
1 674 INCH HOL	LOW STEM AUGER V. BARAZA	
	ARY WASH MOURS	8-SACK CEMENT-SAND
	JUNE GALLONS	toleet
HETHOD OF DECONTAMINATION POPULATION	LESSURE STEAM	TOP OF CASING AT
DEVELOPMENT SEE WELL	- DEVELOPMENT PORM ,	0.2 FEET ABOVE AT BELOW GROUND LEVEL
HE THOD OF		614 INCH DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:	D 2 -
GRM FROM	TO DATE:	X 2 INCH DIAMETER
GPM FROM	TO DATE:	SCHEDULE 40 PVC BLANK CASING
TIME:	DATE:	0.2 to 15.21eer
GPM FROM	DAYE:	SENTONITE CEMENT
GPM FROM	70/	B-SACK CEMENT-SAND
DESCRIPTION	GALLONS	SEAL
TEND OF CLEAR	SLIGHTLY CLOUDY	BENTONITE PELLET
MOD. TU	RBID VERY MUDDY	SEAL 12.5:0 11 'est
VATER:		LULGRAND SILICA 2019
GROUND SUF		SAND PACK 30 to 12.5 feet
DRUMS	OTHER	2 INCH DIAMETER
DEPTH TO WATER AFTER DEVELOPMENT:	FEET	SLOTTED (_0.006
MATERIALS USED	·	15.2 to Z test
3 100 H SACKS OF LOLDRA	DO SILICA ZOLYO SAND	2 INCH DIAMETER
	CEMENT	SCHEDULE 40 PVC BLANK SILT TRAP 25.2 to 27.2 feet
~ 2c GALLONS OF GROUT	USED (PUETLAND TYPEIL W/BENTE	
SACKS OF POWDERED	BENTONITE	BOTTOM WELL CAP
50 POUNDS OF BENTONIT	TE PELLETS	HOLE CLEANED OUT TO
15 FEET OF 2 INCH P	VC BLANK CASING	30 ten
FEET OF TINCH P		BOTTOM OF BOREHOLE
YARDI CEMENT-SAND	IREDI-MIXI USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED?	O TYES	NOTE: MATERIALS WERE
NAME		NOT MEASURED BETTORG
MELL COVER USED: □LOCKING: ©CHRISTY	STEEL COVER	GOING IN WELL JEB
Дотнея		



FIELD WELL COMPLETI	ON FORM	CHRISTY BOX
		LOCKING STEEL COVER
NAME: ERKER ARS	Bx	INCH DIAMETER
NUMBER: 3K98	PROJECT GIC	STEEL CONDUCTOR CASING
LOGGED USB	EDITED DELL	
WELL NAME: THII 02	DATE: /2-//-9/	- INCH DIAMETER
DRILLING A WPOOL		
	DRILLER:	BENTONITE-CEMENT
/ `	ROTARY WASH DRILLED:	
JEED DURING DRILLING:	NONE GALLONS	
PRIOR TO DRILLING:	PRESSURE STEAM	TOP OF CASING AT
DEVELOPMENT SEE WEL	L DEVELOPMENT FORM	i /BELOW GROUND LEVEL
NETHOD OF DEVELOPMENT:		6 1/4" INCH DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:	C :0 30 1eet
YIELD: YIME:	TO DATE:	2 INCH DIAMETER
YIELD: TIME:	TO DATE:	BLANK CASING
TIME:	DATE:	Q-/ 10 /2-5/ feet
GPM FROM	TO DATE:	SEAL OR
GPM FROM	TO	B-SACK CEMENT-SAND
DURING DEVELOPMENT:	GALLONS	
DESCRIPTION DE TURBIDITY DE CLEA	AR SLIGHTLY CLOU	SCAN SENTONITE PELLET
DEVELOPMENT: MOD	TURBID VERY MUDDY	SEAL 9 :0 //_ feet
DOOR OF		[NAME] [NUMBER]
MATER GROUND		SAND PACK // to 2/2 7 feet
ro: □STORM S □DRUMS	EWERS STORAGE TANK	1 1—: 1
DEPTH TO WATER	FEET	2 INCH DIAMETER SLOTTED 1 0.06
MATERIALS USED	PEET	12.4 :0 226 iset
MATERIALS USED	•	
3.5 SACKS OF 5/4/6	5.4.5.6.5. SAN	SCHEDULE 40 PVC
	CEM	.
MZO GALLONS OF GRO	NO IT SALL GUARTING (1030) DATE IN	BENTO, J. TE) BOTTOM WELL CAP
SACKS OF POWDE	RED BENTONITE	€7.Z teet
56 POUNDS OF BENT	ONITE PELLETS	HOLE CLEANED OUT TO
12,4 FEET OF 2 IN	CH PVC BLANK CASING	-30 test
AND REPORT OF PERSONS AND ADDRESS OF THE PERSON ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON ADDRESS OF THE PERSON ADDRESS OF THE PERSON ADDRESS OF T	BEZYCSENTEDSCREEN	BOTTOM OF BOREHOLE
CONTRACTOR OF THE STATE OF THE		
	ANY INEQLAIN ORDERED	NOT TO SCALE
YARD ³ CEMENT-S	AND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED?	□NO □YES	But hile reved is to 2'
NAME		police to suffer and
WELL COVER USED: LOCK		
□CHRIS	STY BOX	



FIELD WELL COMPLETION	N FORM			C	CHRISTY BOX
100 EVALS VES					LOCKING STEEL COVER
NAME: EAKER AFB	BX TPROJECT	(:11 =	ЦЬ	╼┑┈╏╪┼╴	INCH DIAMETER
HUMBER: SK98	MANAGER:	GV6-			CASING
ox: 72R	ev:	BFN			tofeet
NAME: TWIIDS		12 11 91			BOREHOLE
COMPANY: AW POOL					tofeet
EQUIPMENT: 8 6/4 INCH H	OLLOW STEM AUG	ER V. BARAZZA			BENTONITE-CEMENT SEAL OR
INCH R	OTARY WASH	HOURE			3 8-SACK CEMENT-SAND
GALLONS OF WATER USED DURING DRILLING:	NONE	GALLONS			tofeet
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	percoure st	EWA	·	7	TOP OF CASING AT
DEVELOPMENT SEE WELL	_	ENT POISM			O. FEET ABOVE AT
METHOD OF	0000000	/0.7-7-0.7-7-0	.		SELOY GROUND LEVE
DEVELOPMENT:					BOREHOLE
SEGAN DATE:	TIME:	DATE:			0 :0 30 leer
GPM FROM	то	DATE:		 	SCHEDULE 40 PVC
GRM FROM	то				BLANK CASING
GPM FROM	то /	OATE:			A SENTONITE-CEMENT
GPM FROM	то	DATE:	*	1 1	SEAL OR 3 8-SACK CEMENT-SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:	\checkmark	GALLONS			SEAL
DESCRIPTION CLEAR	(\ n	SLIGHTLY CLOUDY		1	feer
AT END OF DEVELOPMENT:	\	VERY MUDDY			BENTONITE PELLET
ODON OF WATER:		<u> </u>	<u>5958</u>	3223	<u>j/ :0 /3 'eet</u>
WATER GROUNDS	URFACE TAN	IK TRUCK	-	=¦•┼─	SAND PACK
TO: STORM SE		RAGE TANK		\equiv	13 10 30 1001
ORUMS ORUMS	Оотн	IER			- INCH DIAMETE
AFTER DEVELOPMENT:		FEET		=	SLOTTED 1 0-0/0
MATERIALS USED					15./ :0 35./ iget
3.5 SACKS OF 51/1	ca Grade			-	INCH DIAMETE
SACKS OF		CEMENT			BLANK SILT TRAP
GALLONS OF GROU		CEM CIVI	546		35.1 10 37/ feet
SACKS OF POWDER			C		- BOTTOM WELL CAP
50 POUNDS OF BENTO					HOLE CLEANED OUT 1
15 FEET OF 2 INC		ING			30 ten
10 FEFT OF E INC					- BOTTOM OF BOREHOL
C. PARISTONIA					
YANU=GEMENTSA	NO IKIMIO JIJI ON	DERED			
YARDI CEMENT-SA			ACO:	TIONAL INS	ORMATION:
	□NO □YES				0.060 1/8/72
NAME					
WELL COVER USED: LOCKIE	NG STEEL COVER				
☐ CHRIST					



FIELD WELL COMPLETIO	N FORM				CHRISTY BOX
100			i In		LOCKING STEEL COVER
HAME: EAKER AFB	PROJECT		· 니_		STEEL CONDUCTOR
HUMBER: 3K98	MANAGER:	GYG	-		CASING
** BFN	BY:	BFN	.		INCH DIAMETER
NAME: TWIIO4		12-11-91			BOREHOLE
COMPANY: A.W. POOL			.		
EQUIPMENT: 10CH H	OLLOW STEM AUG	ER V. RARB Z Z A			BENTONITE-CEMENT SEAL OR
INCH RO	DTARY WASH	HOURS ORILLED:			- 8-SACK CEMENT-SAND SEAL
GALLONS OF WATER USED DURING DRILLING:	one	GALLONS	•		
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	Pressuae s	team	,		TOP OF CASING AT
DEVELOPMENT SEE DEVE					FEET ABOVE AT
METHOD OF DEVELOPMENT:					-614 INCH DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:		•	-	BOREHOLE 0 :0 30 leet
VIELD: TIME!		DATE:	•		- 2 INCH DIAMETER
YIELDI YIMEI	70	DATE:	-		SCHEDULE 40 PVC BLANK CASING
GPM FROM	то /	DATE:			0.1 10 14.1 feet
GPM FROM	то./	DATE		• -	SENTONITE-CEMENT
GPM FROM					SEAL OR B-SACK CEMENT-SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS			SEAL 10 10 ~ U.S feet
DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: MOD. T	\ <u> </u>	SLIGHTLY CLOUDY			BENTONITE PELLET
000# 0#		×	. 🎇	8 323	10 :0/2 'est
WATER:	URFACE TTAN	IK TRUCK			SAND PACK
TO: USTORM SEY		RAGE TANK	Δ 0		12 10 30 1001
DRUMS	Оотн	IER			2 INCH DIAMETE
DEPTH TO WATER AFTER DEVELOPMENT:		FEET	1		SLOTTED (0.0/
MATERIALS USED					14.1 :0 74.1 iees
2.5 SACKS OF Silica	Grade	SAND		-	- DINCH DIAMETE
SACKS OF		CEMENT			BLANK SILT TRAP
GALLONS OF GROU					
SACKS OF POWDERS		in the I w/beam	chite)	C	BOTTOM WELL CAP
SACKS OF POWDER!					HOLE CLEANED OUT
14 FEET OF 2 INCH		ING			30 1mm
	PVC BLANK CAS		L		- BOTTOM OF BOREHOL
the state of the s					
12 ()	CONCOUNTY) OR	DERED	NO)1°16'30	
YARD ³ CEMENT-SAA					NFORMATION:
	NO DYES		AL	STITUTAL II	TOTAL TOTAL
NAME	7				
WELL COVER USED: TOCKIN			·		
□CHRIST	r BOX				



FIELD WELL COMPLETION	FORM	☐ CHRISTY BOX
108	•	☐ LOCKING STEEL COVE
NAME: EAKER AFR	PROJECT	STEEL CONDUCTOR
NUMBER: 3K98	MANAGER: GVG	CASING
ev: BFN	10 v: BFN /353	tofeet
NAME: E//TWOS	DATE: 12/13/91	BOREHOLE
COMPANY: Pol L	Orilling	tofeet
EQUIPMENT: 644 INCH HOL	LOW STEM AUGER V. Burazza	BENTONITE CEMENT
INCH ROT	HOURS	B-SACK CEMENT-SAND
GALLONS OF WATER USED DURING DRILLING: NOA		toleet
METHOD OF DECONTAMINATION		TOP OF CASING AT
2/64	CHEROLD CONTRINS PREE	2.3 FEET ABOVE A
METHOD OF PRODUCT	; was not Developed	GELOW GROUND LEV
DEVELOPMENT:		BOREHOLE
SEGAN DATE:	TIME:	0 :0 25 teet
GPM FROM	TO DATE:	Z INCH DIAMETE
GPM FROM	то	BLANK CASING
GPM FROM	.TO Dafe:	0.3 to 13.4 feet
YIELD: TIME:	TO DATE:	SEAL OR
TOTAL WATER REMOVED	GALLONS	8-SACK CEMENT-SANI
DURING DEVELOPMENT:		9 .00.5 feet
OF TURBIDITY CLEAR AT END OF DEVELOPMENT:	SLIGHTLY CLOUDY	BENTONITE PELLET
ODOR OF	MARIO D VERY MUDDY	9 :0 // 'eet
WATER:		CO-O-RADE SILICA
DISCHARGED DEFOUND SUITO:		SAND PACK
DRUMS	OTHER	2 INCH DIAMET
DEPTH TO WATER AFTER DEVELOPMENT:	FEET	SLOTTED : 0-0/0
MATERIALS USED		IS. Y . O BY iget
2		2 INCH DIAMET
	A 61-1e 20/40 SAND	SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF		23.4 to 25.5 leet
	USED (PORTLAND TYPE I CEMENT, BENTON TE)	BOTTOM WELL CAP
SACKS OF POWDERE	DRENIONITE	25. Sicet
POUNDS OF BENTON		HOLE CLEANED OUT
	PVG-BLANK-CASING	25.5 (70)
- 2.1 - U = 3	THE PROPERTY AND ADDRESS OF THE PARTY AND ADDR	25
=		
YARD3 CEMENT-SANI		NOT TO SCALE
YARD3 CEMENT-SAN	D (REDI-MIX) USED	ADDITIONAL INFORMATION:
_	NO TYES	
NAME		
WELL COVER USED: ALOCKING	STEEL COVER	
OTHER		



FIELD WELL COMPLETION	FORM	CHRISTY BOX
J00 Enum 4.50		INCH DIAMETER
HAME: EAKER APB	PROJECT George Gartse	- HI STEEL CONDUCTOR
- NUMBER: 3K98	COLTED	
·v: URE	BFN PATENISIA	- INCH DIAMETER
NAME: ELLIWOG		BOREHOLE
COMPANY: Pool	Drilling DRILLER:	BENTONITE-CEMENT
EQUIPMENT: 44 INCH HO	LLOW STEM AUGER V. Parrez	I I I I I I I I I I I I I I I I I I I
INCH RO	TARY WASH PRILLED: 1.2	SEAL
	ONE GALLONS	
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	HIGH PRESSURE STEAM	TOP OF CASING AT
DEVELOPMENT SEE WE		BELOW GROUND LEVEL
METHOD OF DEVELOPMENT:		SOREHOLE
DEVELOPMENT BEGAN DATE:	TIME:	BOREHOLE +0.0 :0 29 teet
YIELD: TIME:	TO DATE:	a INCH DIAMETER
GPM FROM	DATE:	SCHEDULE 40 PVC BLANK CASING
GPM FROM	TO DATE:	-0.3 to 13,50 feet
GPM FROM	TO DATE:	BENTONITE CEMENT
GPM FROM	το	■ SACK CEMENT SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:	GALLONS	
OF TURBIDITY DELEAR		Y BENTONITE PELLET SEAL
DEVELOPMENT: MOD. 1	TURBID VERY MUDDY	9 :0 11 'eet
ODOR OF WATER:		COLORADE SILICE ZO/
WATER GED GROUNDS	- \	SAND PACK
TO: STORM SEV	VERS STORAGE TANK	A INCH DIAMETER
DEPTH TO WATER AFTER DEVELOPMENT:	FEET	SLOTTED! .CCG
MATERIALS USED		-13.50 to 23.76 feet
		2 INCH DIAMETER
3.5 SACKS OF		BLANK SILT TRAP
SACKS OF		
	ITUSED (CEMENT/BENTON	TE BOTTOM WELL CAP
SACKS OF POWDER		HOLE CLEANED OUT TO
POUNDS OF BEILTO		fret
	H PVC BLANK CASING	
2.00 PERM		
		NOT TO SCALE
	MO INEDI-MIXI ONDERED	ADDITIONAL INFORMATION:
YARD CEMENT-SA	. /	AUDITIONAL INFORMATION
CONCRETE PUMPER USED?	MNO TAEZ	
WELL COVER USED: LOCKI	NG STEEL COVER	
CHRIS	TY BOX	



FIELD WELL COMPLETION FORM	CHRISTY BOX
100 (0.45)	LOCKING STEEL COVER
NAME: EAKER ATB	TINCH DIAMETER STEEL CONDUCTOR
NUMBER: 309 MANAGER: GV G	CASING
The or GFN	tofeet
NAME: EIITU 07 12/13/91	BOREHOLE
COMPANY: A.W. POOL	
EQUIPMENT: TITINCH HOLLOW STEM AUGER V. BAYLAZZO	BENTONITE CEMENT SEAL OR
INCH ROTARY WASH DRILLEDIO. 75	8 SACK CEMENT-SAND
GALLONS OF WATER	
PRESSURE STEAM	TOP OF CASING AT -0.15 FEET ABOVE AT
DEVELOPMENT SEE DEVELOPMENT FORM	I I I RELOW GROUND LEVEL I
METHOD OF DEVELOPMENT:	7 1/4 INCH DIAMETER
DEVELOPMENT BEGAN DATE: TIME:	1991 <u>C.S.O.</u>
VIELD: TIME: DATE	a INCH DIAMETER
YIELD: TIME: GPM FROM TO	SCHEDULE 40 PVC BLANK CASING
YIELD: TIME: DATE:	-0.15 to 15.07 feet
GPM FROM TO	SEAL OR
GPM FROM TO	8 SACK CEMENT-SAND
DURING DEVELOPMENT: GALLONS	
OFSCRIPTION OF TURBUTY	BENTONITE PELLET
DEVELOPMENT: MOD. TURBID VERY MUDDY	SEAL 11 :0 13 'eet
ODOR OF WATER:	Quanapo 20/40
WATER GEORGE GROUND SURFACE TANK TRUCK	SAND PACK
TO: STORM SEWERS STORAGE TANK	
DEPTH TO WATER	SLOTTED 10-00 (
AFTER DEVELOPMENT: FEET	(#ch · SCREEN
MATERIALS USED	-15.07 to 25.15
21/2 SACKS OF COLO. SILICA 20140 SAND	2 INCH DIAMETER SCHEDULE 40 PVC
SACKS OFCEMENT	8LANK SILT TRAP - 35.15 1027.15 1001
GALLONS OF GROUT USED	BOTTOM WELL CAP
SACKS OF POWDERED BENTONITE	-37.15 len
50 POUNDS OF BENTONITE PELLETS	HOLE CLEANED OUT TO
14.92 FEET OF 2 INCH PVC BLANK CASING	3000
8 H 4 3 SHE FEET OF 2 INCH PVC SLOTTED SCREEN	BOTTOM OF BOREHOLE
2.00 tell 100 100 100 100 100 100 100 100 100 1	100
YARO CEMENT SAND (REDI MIX) ORDERED	NOT-TO SCALE
YARD CEMENT-SAND (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? ZINO TYES	WETGO
NAME	WELL ABANDONED : 18/92
WELL COVER USED: X LOCKING STEEL COVER	
CHRISTY BOX	
OTHER	j



FIELD WELL COMPLETION	N FORM	CHRISTY BOX
TELD HELL COMPLETION		LOCKING STEEL COV
HAME EAKER AFB		INCH DIAMETEI
NUMBER: 3K98	PROJECT GVG	STEEL CONDUCTOR CASING
LOGGED LRE	EDITED BEN	
WELL EUTWILDS	DATE: 14/91	INCH DIAMETE
COMPANY: A.W. POOL		tofeet
· · · · · · · · · · · · · · · · · · ·	LLOW STEM AUGER V. BARRAZZE	BENTONITE CEMENT
	TARY WASH DRILLED: 0,75	8 SACK CEMENT-SAN
GALLONS OF WATER		tofeet
METHOD OF DECONTAMINATION	SNE GALLONS	
PRIOR TO DRILLING:	STEAM (HIGH PRESSURE)	TOP OF CASING AT
DEVELOPMENT SEE WEZ	L DEVELOPMENT TOKON	SELOW GROUND LEV
METHOD OF DEVELOPMENT:		BOREHOLE
DEVELOPMENT BEGAN DATE:	TIME:	0:0291001
TIME! GPM FROM	TO DATE:	2 INCH DIAMETI
TIELDI TIMEI	TO DATE:	SCHEDULE 40 PVC BLANK CASING
VIELD: TIME	TO DATE:	0,2 to 8,25 feet
GPM FROM	DATE:	SEAL OR
GPM FROM	10	8-SACK CEMENT-SAN
DURING DEVELOPMENT:	GALLONS	
OF TURBIDITY CLEAR	SLIGHTLY CLOUDY	BENTONITE PELLET
DEVELOPMENT: MOD. 1	TURBIO VERY MUDDY	SEAL 4:0_6 'eet
ODOR OF WATER:		Coce. Silven 2014
WATER GROUNDS		SANO PACK
, TO: □STORM SEV □DRUMS	VERS STORAGE TANK	a INCH DIAMET
DEPTH TO WATER		SLOTTED (.OOC
AFTER DEVELOPMENT:	FEET	8.20 to 23.20 feet
MATERIALS USED		2 INCH DIAMET
2.5 SACKS OF 5// C	a Grade SAND	SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF	CEMENT	23.20 to 25.20 feet
GALLONS OF GROU	T USED	BOTTOM WELL CAP
SACKS OF POWDER	ED BENTONITE	2 <u>5.20</u> test
50 POUNDS OF BENTO		HOLE CLEANED OU
8.00 FEET OF 2 INC		<u>25</u> (m
15,00 FEET OF 2 INCH	I PVC SLOTTED SCREEN	BOTTOM OF BOREH
YARO3 CEMETOLE		NOT TO SCALE
YARDI CEMENT-SA	MD TREDI-MIX) USED	ADDITIONAL INFORMATION: Well
CONCRETE PUMPER USED?	XNO □YES	Full recovery on well screen & Riser. Borchole A cutilled with 250 sal
NAME		full recovery on well
WELL COVER USED: DEOCKIE		Screen & RISCR. Borchole
☐ CHRIST		11/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1



SACKS OF GROUND SUFFACE TANK TRUCK STELLOND SUFFACE STELL CONDUCTOR STELLOND APPRIL STE	FIELD WELL CO	MPLETION FOR	IM				CHRISTY BOX
OBJECTION OF MARKET STAND STAND OF STAN	100 EAKEN	. A E-0					
DEVELOPMENT SET WELL DEVELOPMENT FORM DEVELOPMENT TIME TOP OF CASING AT TOP OF CASING AT TOP OF CASING AT OPPORTUNITY TIME DEVELOPMENT TIME TOP OF CASING AT TOP OF CASING AT OPPORTUNITY TIME DEVELOPMENT TIME TOP OF CASING AT TOP OF CASING AT OPPORTUNITY TIME TOP OF CASING AT OPPORTUNITY TIME TOP OF CASING AT OPPORTUNITY TIME TOP OF CASING AT OPPORTUNITY TIME TOP OF CASING AT OPPORTUNITY TIME TOP OF CASING AT OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY TIME OPPORTUNITY OPPORTUNITY TIME OPPORTUNI		1	SECT CI	^	41-1	-	STEEL CONDUCTOR
THE CONTROL OF THE CO			TED				-
SOUTHWENT OF THICH HOLLOW STEM AUGER CONTINUES. SECONDARY INCH HOLLOW STEM AUGER CONTINUES. SECONDARY SEC	v: LICE		BF				
SOURCETT PUMPER USED) SOURCETT PUMPER AND STEM AUGER SOURCE OF SEAL OR SEAL	AME: ELITU	J1109		2/14/91			
INCH ROTARY WASH SALLORE OF WATER. ALLORE OF WATER. ALLORE OF WATER. ASTRONO OF OECONYAMINATION: INCH DEVELOPMENT SEE WELL DEVELOPMENT FORM SEVENDMENT SEE WELL DEVELOPMENT FORM SEVENDMENT: SEVENDMENT SEE WELL DEVELOPMENT FORM SEVENDMENT: SEVE	ORILLING A. W	1. POOL					
INCH ROTARY WASH SALLONS OF WATER IN. ALLONS OF WATER IN. ALLONS OF GALLONS ALLONS OF GALLONS ALLONS OF GALLONS ALLONS OF GALLONS ALLONS OF GALLONS ALLONS OF GALLONS ALLONS OF GROUND LEVEL ALLONS OF GROUND SURFACE TIME: SEAR OF GALLONS ALLONS OF GROUND SURFACE ALL	COUIPMENT:	14 INCH HOLLOWS	TEM AUGER	RARRAZZO			
TOP OF CASING AT TOP OF		INCH ROTARY V	HO	ues .50		1 1	8-SACK CEMENT-SAND
TOP OF CASING AT TOP OF			10	BFR	•••	•	
DEVELOPMENT SEE WELL DEVELOPMENT FORM ASTRODORY ASTRO	METHOD OF DECONT	FAMINATION (TOR OS 0151110 AT
SECURIOR SERVICE STATE S					1		-0.7 FEET ABOVE AT
TIMES TIMES THES	ETHOD OF	366 0000 00	20 CCP PINEDIO	P0:9M			GELOW GROUND LEVEL
TIME: Comparison Compariso	EVELOPMENT:	7				.	BOREHOLE
GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GM FROM TO GALLONS GENTONITE-CEMENT-SAND SEAL OR GSAL OR GROUND SURFACE TANK TRUCK GO JOST OR GROUND SURFACE TANK GO JOST OR GROUND SURFACE TANK GO JOST OR GROUND SURFACE TANK GO JOST OR GROUND SURFACE TANK GO JOST OR GROUND SURFACE TANK GO JOST OR GROUND SURFACE TANK GO JOST OR GROUND SURFACE TANK GROUND GROUND SURFACE GROUND SURFACE SAND PACK SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAL OR SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK SAND PACK	EGAN DATE:						
SEAL OF SAND SEWERS STORAGE TANK GALLONS GROUND SURFACE TANK TRUCK GOOD STORM SEWERS STORAGE TANK GALLONS GROUND SURFACE TANK TRUCK GOOD STORM SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORM SEWERS STORAGE TANK GOOD STORM SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORAGE TANK GOOD STORAGE TANK GOOD STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORE SEWERS STORAGE TANK GOOD STORAGE TANK GOO	GPM F	ROM TO				4	2 INCH DIAMETER
GPM FROM TO GPM FROM TO GPM FROM TO GPM FROM TO GRAPH TO GPM FROM TO GRAPH GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH TO GRAPH GRAPH TO GRAPH GRAPH TO GRAPH GRAPH GRAPH TO GRAPH GR			DA	TE:			BLANK CASING
SENTONITE-CEMENT GPM FROM TO GATE: GPM FROM TO GALLONS GROUND SURFACE GANK GALLONS GALLONS GALLONS GROUND SURFACE GANK GALLONS GROUND GALLONS GAL			DA	TE:			-0.2 10 8.30 feet
SACK CEMENT-SAND SEAL OF THE SECRIPTION SEACH PRODUCT SEA	IELD: T	IME:	DA	TE:		•	
CLEAR SLIGHTLY CLOUDY SENTONITE PELLET SEAL	OTAL WATER REM	DVED				•	8-SACK CEMENT-SAND
SACKS OF COLORLADOSILICA 20/40 SAND SACKS OF COLORLADOSILICA 20/40 SAND SACKS OF FOWDERED BENTONITE SACKS OF FOWDERED BENTONITE POUNDS OF BENTONITE PELLETS SACKS OF FEET OF INCH PVC SLANK CASING [O.00 FEET OF INCH PVC SLOTTED SCREEN YARD CEMENT-SAND (REDI-MIX) USED SOURCETE PUMPER USED? ADDITIONAL INFORMATION: SOURCE BENTONITE PELLETS SOURCE CLEANED OUT TO SCALE YARD CEMENT-SAND (REDI-MIX) USED ADDITIONAL INFORMATION: SOURCE PUMPER USED? ADDITIONAL INFORMATION: SOURCE CLEANED OUT TO SCALE YARD CEMENT-SAND (REDI-MIX) USED ADDITIONAL INFORMATION: SOURCE PUMPER USED? SOURCE CLEANED OUT TO SCALE ADDITIONAL INFORMATION: SOURCE CLEANED OUT TO SCALE ADDITIONAL INFORMATION: SOURCE CLEANED OUT TO SCALE ADDITIONAL INFORMATION: SOURCE CLEANED OUT TO SCALE CONCRETE PUMPER USED? CONCRETE PUMPER USED? CHARISTY BOX	ESCRIPTION	_			****		10 feet
GROUND SURFACE TANK TRUCK SAND PACK SAND P	T END OF	Ξ	_				
MATERIALS USED SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF POWDERED BENTONITE SOLUTION SACKS OF POWDERED BENTONITE SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SOLUTION SALICA MARIE SAND PACK SAND SACKS OF COUNTADOSILICA SOLUTION SACKS OF COUNTADOSILICA SOLUTION SACKS OF POWDERED BENTONITE SOLUTION SOL	2008.05	MOD. TURBIO	U VERY	MUDDY		***	4:06
SAND PACK STORM SEWERS STORAGE TANK DRUMS STORAGE TANK DRUMS STORAGE TANK DRUMS STORAGE TANK SLOTTED :	VATER:	_					Nemel (maner)
DRUMS OTHER DEPTH TO WATER MATERIALS USED AS SACKS OF COLORADO SILICA OLY SAND SAC	DISCHARGED _	_		-		$\equiv \mid \mid$	SAND PACK
AATERIALS USED 2.5 SACKS OF COLONADOSILICA 30/40 SAND SACKS OF CEMENT GALLONS OF GROUT USED SACKS OF POWDERED BENTONITE POUNDS OF BENTONITE PELLETS 8.00 FEET OF INCH PVC BLANK CASING 10.00 FEET OF INCH PVC BLANK CASING YARD CEMENT-SAND (REDI-MIX) ORDERED NOT.TO SCALE ADDITIONAL INFORMATION: CONCRETE PUMPER USED? NO TYES NAME WELL COVER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER CONCRETE PUMPER USED: ELOCKING STEEL COVER		-		IANK	0 0		
MATERIALS USED ASSOCIATION STATE OF COLORADOS ILICA SOLUTION SAND SACKS OF COLORADOS ILICA SOLUTION SAND SACKS OF COLORADOS ILICA SOLUTION SAND SACKS OF COLORADOS ILICA SOLUTION SAND SACKS OF COLORADOS ILICA SOLUTION SAND SCHEDULE 40 PVC BLANK SILT TRAP BOTTOM WELL CAP ADDITION SOLUTION SOL		NT:		· T			
SACKS OF COLORADO SILICA COLO SAND SACKS OF CEMENT GALLONS OF GROUT USED SACKS OF POWDERED BENTONITE POUNDS OF BENTONITE PELLETS POUNDS OF BENTONITE PELLETS POUNDS OF FEET OF INCH PVC BLANK CASING [O.GO FEET OF INCH PVC SLOTTED SCREEN YARD CEMENT-SAND (REDI-MIX) ORDERED YARD CEMENT-SAND (REDI-MIX) USED CONCRETE PUMPER USED? NOTION SCALE ADDITIONAL INFORMATION: Borg. Hole. Calved in 3 1			7-61	• '			inch : SCREEN
SACKS OF							2
GALLONS OF GROUT USED SACKS OF POWDERED BENTONITE SO POUNDS OF BENTONITE PELLETS POUNDS OF BENTONITE PELLETS ROO FEET OF INCH PVC BLANK CASING OOO FEET OF INCH PVC SLOTTED SCREEN YARD CEMENT-SAND (REDI-MIX) ORDERED TARD CEMENT-SAND (REDI-MIX) USED CONCRETE PUMPER USED? NOT TO SCALE ADDITIONAL INFORMATION: BOTTOM OF BOREHOLE ADDITIONAL INFORMATION: BOTTOM OF BOREHOLE CONCRETE PUMPER USED? MAME WELL COVER USED: ELOCKING STEEL COVER	SACKS	of Colonadi	osiuca 30/1	SAND		•	30
GALLONS OF GROUT USED SACKS OF POWDERED BENTONITE POUNDS OF BENTONITE PELLETS POUNDS OF BENTONITE PELLETS POUNDS OF BENTONITE PELLETS HOLE CLEANED OUT TO 22 1991 BOTTOM WELL CAP 20.201eer HOLE CLEANED OUT TO 22 1991 BOTTOM OF BOREHOLE PARD CEMENT-SAND (REDI-MIX) ORDERED NOT.TO SCALE YARD CEMENT-SAND (REDI-MIX) USED ADDITIONAL INFORMATION: BY CHARLE CAPELLO OF BOTTOM OF BOREHOLE CONCRETE PUMPER USED? MELL COVER USED: PLOCKING STEEL COVER CHRISTY BOX	SACKS	OF		CEMENT			18.20,000
SACKS OF POWDERED BENTONITE POUNDS OF BENTONITE PELLETS 8.00 FEET OF 2 INCH PVC BLANK CASING 10.00 FEET OF 2 INCH PVC SLOTTED SCREEN YARD CEMENT-SAND (REDI-MIX) ORDERED YARD CEMENT-SAND (REDI-MIX) USED CONCRETE PUMPER USED? NOTIO SCALE ADDITIONAL INFORMATION: Burc. Hule: cuyeel in 3 ' NAME WELL COVER USED: ELOCKING STEEL COVER CICHRISTY BOX	GALLO	NS OF GROUT USED			1913		
TO FEET OF INCH PVC BLANK CASING O.GO FEET OF INCH PVC SLOTTED SCREEN	SACKS	OF POWDERED BENT	TONITE				20.20leet
FEET OF INCH PVC BLANK CASING O.OO FEET OF INCH PVC SLOTTED SCREEN	SO POUND	S OF BENTONITE PEL	LLETS				HOLE CLEANED OUT TO
O.OO FEET OF INCH PVC SLOTTED SCREEN BOTTOM OF BOREHOLE 2.5 IN	8.00 FEET 0	F_2 INCH PVC BL	ANK CASING				22 1991
YARD CEMENT-SAND (REDI-MIX) ORDERED YARD CEMENT-SAND (REDI-MIX) USED ADDITIONAL INFORMATION: CONCRETE PUMPER USED? NO DYES Burg. Hule cuyeel 1. 3.1 NAME MELL COVER USED: BLOCKING STEEL COVER DCHRISTY BOX					Ľ.		BOTTOM OF BOREHOLE
YARD CEMENT-SAND (REDI-MIX) ORDERED NOT-TO SCALE YARD CEMENT-SAND (REDI-MIX) USED ADDITIONAL INFORMATION: CONCRETE PUMPER USED? NO DYES NAME MELL COVER USED: BLOCKING STEEL COVER DCHRISTY BOX				Danjara,			<u>Ø-2</u> -16#
YARD CEMENT-SAND (REDI-MIX) USED ADDITIONAL INFORMATION: Borg. Hule. Cuyeel in 3 ' NAME WELL COVER USED: ELOCKING STEEL COVER CHRISTY BOX					NO1	TO SCAL	E
NAME				· www.			
WELL COVER USED: ELOCKING STEEL COVER							
ДСНЯІЗТУ ВОХ	NAME				Durc.	(MYCLE IN S
ДСНЯІЗТУ ВОХ	WELL COVER USED:	ELOCKING STEEL	COVER			· · · · · · · · · · · · · · · · · · ·	
OTHER		CHRISTY BOX					



FIELD WELL COMPLETI	ON FORM		CHRISTY BOX
100			LOCKING STEEL COVE
NAME: FAICEN	PROJECT C.AC		STEEL CONDUCTOR
HUMBER: 3K98	PROJECT GVG		CASING
ev: CRE	BFN BFN		- INCH DIAMETER
NAME: EIIIWIIIO	12/1	4191	BOREHOLE 1000
COMPANY: A VO 1000			BENTONITE CEMENT
EQUIPMENT: 614 INCH	HOLLOW STEM AUGER V. BAR	PAZZA	SEAL OR SEAL OR SEAL OR
	ROTARY WASH DRILLED:	55	SEAL .
GALLONS OF WATER USED DURING DRILLING:	NONE GALLONS	•	
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	" HIGH PRESSURE STEA	m I	TOP OF CASING AT
DEVELOPMENT SEE WE	ell development for	M	FEET ABOVE A
METHOD OF DEVELOPMENT:			- 614 INCH DIAMETE
DEVELOPMENT BEGAN DATE:	TIME:		BOREHOLE O to 35 1 seet
VIELDI GPM FROM	TO DATE:		_ 2 INCH DIAMETE
YIELD: TIME:	DATE		SCHEDULE 40 PVC BLANK CASING
GPM FROM	TO OATE:		-0.20 to -8.20 feet
GPM FROM	TO	+-	BENTONITE CEMENT
GPM FROM	70 /	+	B SACK CEMENT SAN
DURING DEVELOPMENT:	GALLONS	<u> </u>	4 10 25 1 mm
OF TURBIDITY CLEA	R ☐SLIGHTLY CI	.OUDY	BENTONITE PELLET
	TURBID VERY MUDD	<u>′ </u>	4 :0 6 'eet
ODOR OF WATER:	``.		Countain Silver 50/42
DISCHARGED GROUND	- · · · · · · · · · · · · · · · · · · ·		SAND PACK
DRUMS	OTHER		
DEPTH TO WATER AFTER DEVELOPMENT:	FEET		SLOTTED 1 . 00 6
MATERIALS USED			-8. 2c :0-18.20 inet
3.5 SACKS OF 30	lica Gorde	SAND	- INCH DIAMET
SACKS OF		SAND	BLANK SILT TRAP
	DUTUSED (LOMENT/BENT		
SACKS OF POWDE		/	BOTTOM WELL CAP
50 POUNDS OF BENT			HOLE CLEANED OU
8.00 FEET OF 2 IN	CH PVC BLANK CASING		22170
10.00 FEET OF 2 IN			BOTTOM OF BOREH
2 room Free of			25 100
YARO CEMENTA	MO INCOME TO LOCATE	NOT TO SCALE	•
YARD CEMENTS	AND THE DIMINITY USED	ADDITIONAL	NFORMATION:
CONCRETE PUMPER USED?	SHO DAEZ		
NAME			
WELL COVER USED: DCHRI	ING STEEL COVER		
□ CHRI □ OTHE			



FIELD WELL COMPLETION	FORM			CHRISTY BOX
FIELD HELL COMPLETION			П	T LOCKING STEEL COVER
NAME: EAKER AFB	PROJECT		4	STEEL CONDUCTOR CASING
HUMBER: 3K98	MANAGER: CH			
LOGGED BFKI	SA: 12			INCH DIAMETER
WELL EITWILL		12-15-91		BOREHOLE
DRILLING COMPANY: POO/				BENTONITE-CEMENT
	LLOW STEM AUGER	V. Barrazza		SEAL OR 8-SACK CEMENT-SAND
-	TARY WASH	HOURS DRILLED: 42		SEAL .
GALLONS OF WATER	೧೮ ೪೮	GALLONS		toleet
METHOD OF DECONTAMINATION PRIOR TO DRILLING: HGH	pressure "	STEAM		TOP OF CASING AT
	TL DEVELOPA			FEET ABOVE AT BELOW GROUND LEVEL
METHOD OF		<u> </u>	,	6 1/4 INCH DIAMETER
DEVELOPMENT:			! -	BOREHOLE O to 22 Int
SEGAN DATE:	TIME:	DATE:		Z INCH DIAMETER
GPM FROM	TO	DATE:		SCHEDULE 40 PVC BLANK CASING
GPM FROM	то	DATE		0./ 10 8./ feet
GPM FROM	то	DATE:		SEAL OR
GPM FROM	то			R.SACK CEMENT SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:	\times	GALLONS		SEAL 5.5 10~0.5 feet
DESCRIPTION DELEAR	sı	IGHTLY CLOUDY		BENTONITE PELLET
AT END OF DEVELOPMENT: MOD.	TURBIO 🗋 V	ERY MUDDY		SEAL 5.5 10 6.5 1001
ODOR OF WATER:		•		CELERADE SILICA ZO/S
WATER GROUNDS	URFACE TANK	TRUCK		SAND PACK 6.5 to 2-2 leet
TO: STORM SET	_	AGE TANK		Z INCH DIAMETER
DEPTH TO WATER	□отне			SLOTTED 1 0.006
AFTER DEVELOPMENT:		FEET		8 / :0 /8 / iest
MATERIALS USED				Z INCH DIAMETER
2.5 SACKS OF _5/1	CA Grade	SAND	111	SCHEDULE 40 PVC BLANK SILT TRAP
SACKS OF		CEMENT		18.1 to 20.1 feet
~≤ GALLONS OF GROW	UT USED (EMEN	UT /BENTON:TE	mix)	BOTTOM WELL CAP
SACKS OF POWDER	RED BENTONITE	,		<u>∂0./</u> teet
25 POUNDS OF BENTO	NITE PELLETS			HOLE CLEANED OUT TO
8 FEET OF 2 INC	H PVC BLANK CASI	NG		
10 FEET OF Z INC	H PVC SLOTTED SCR	IEEN	,	BOTTOM OF BOREHOLE
YARO	JEDIMIXI ORC	DERED	NOT TO S	CALE _
TAND GARAGE	DIO DESIGNATIONE	D .	ADDITIO	NAL INFORMATION:
CONCRETE PUMPER USED?	MNO DAEZ			
NAME			-	
WELL COVER USED: DOCK				
CHRIS				



;

HELD WELL COMPLET	ON FORM		CHRISTY BOX	
TELD HELL COMPLET			LOCKING STEEL	.COVER
AME: EAKEL AFB			INCH DIA	
0.0	PROJECT MANAGER: G	VG	STEEL CONDUC	TOR
IUMBER: 3KYE				eet
ogged v: BFK/	EDITED	DATE:	INCH DIA	METER
NELL EIMMIZ		12-15-91	BOREHOLEto	feet
OMPANY: Pool Drilling	15		BENTONITE-CE	
	HOLLOW STEM AUGER	DRILLER:	SEAL OR	1
	ROTARY WASH	HOURS 1.25	8-SACK CEMEN	SANU
	THUTANT WAST	<u> </u>	10	feet
ALLONE OF WATER ISED DURING DRILLING:	とらんで	GALLONS		
METHOD OF DECONTAMINAT PRIOR TO DRILLING:	Steam cleaned		TOP OF CASING	
DEVELOPMENT SEE W	ELL DEVERCEME	NT FORM	MELON GROUN	O LEVE
NETHOD OF DEVELOPMENT:			BOREHOLE	METER
DEVELOPMENT	TIME		0:0 25	, l eet
SEGAN DATE:		DATE:	a INCH DI	AMETER
SPM FROM	TO	DATE	SCHEDULE 40 BLANK CASING	
GPM FROM	то	DATE	0.1 10 8.1	
TIME:	то	DATE	SENTONITE-CI	EMENT
TIME:	то	DATE	SEAL OR B.SACK CEMEN	IT-SAND
TOTAL WATER REMOVED		GALLONS	SEAL	4
DESCRIPTION			2000	feet
OF TURBIDITY UCLE		IGHTLY CLOUDY	BENTONITE PI	_
DEVELOPMENT: MO	O. TURBIO DV	ERY MUDDY	5 : 6:3	,
ODOR OF WATER:		` .	COLOGABE SICI	(number
WATER / GROUN	D SURFACE TANK	TRUCK	SAND PACK	
TO: STORM		AGE TANK		_ 1001
DRUMS	Оотне	R	SLOTTED 1	
DEPTH TO WATER AFTER DEVELOPMENT:		FEET	- nan SCREEN	4
MATERIALS USED			9.1 :0 23.1	_ iset
		4	SCHEDULE 40	
3:5 SACKS OF		SAND	BLANK SILT	TRAP
SACKS OF		CEMENT	23.1,025.	Lieut
GALLONS OF G	ROUT USED		BOTTOM WEL	L CAP
SACKS OF POW	DERED BENTONITE		<u>∂5./</u> teet	
35 POUNDS OF BEI	NTONITE PELLETS		HOLE CLEAN	ED OUT
	INCH PVC BLANK CASI	NG	<u> 25-/</u> 1 -et	
15 FEET OF 2	INCH PVC SLOTTED SC8	EEN	BOTTOM OF I	JOREHO
YARD CEMEN	T-SAND (REDI-MIX) ORQ	ERED	NOTACSCALE	
-	T-SAND (REDI-MIXTUSE		ADDITIONAL INFORMATION:	
CONCRETE PUMPER USED?	\ \ \		material WAS pulle	d s'
NAME	المارية المارية		Growted to Surface	07 121
WELL COVER USED: ALO	CKING STEEL COVER		Grouted to Surface,	11 ====
	RISTY BOX		•	1. 3crc
- -	HER	·	FRISCA	



FIELD WELL COMPLETION FORM			CHRISTY BOX		
100 501/50 00			LOCKING STEEL COVER		
OB 3raa		VG-	4	STEEL CONDUCTOR	
				CASING	
LRE LRE	10Y: 15P			INCH DIAMETER	
AME: EIITWII	13	12/15/91		BOREHOLE	
MILLING AWPO	DL			10	
		DRILLER		- BENTONITE-CEMENT	
/ ~	HOLLOW STEM AUGER	V-DAKAA ZA		SEAL OR 8-SACK CEMENT-SAND	
		DRILLED:		SEAL	
ALLONS OF WATER SED DURING DRILLING:	30	ALLONS .			
ETHOD OF DECONTAMINATION TO DRILLING:	HIGH PRESS	URE STEAM		TOP OF CASING AT	
DEVELOPMENT SEE W	ELL DEVELOP.	MENT FORM		PELOW GROUND LEVEL	
TETHOD OF SEVELOPMENT:				- 6'4 INCH DIAMETER	
EVELOPMENT	TIME:			BOREHOLE C 127 feet	
TIME:		DATE:		Z INCH DIAMETER	
GPM FROM		DATE:		SCHEDULE 40 PVC BLANK CASING	
GPM FROM	то	DATE:		0.15 to 8.35 feet	
GPM FROM	то	DATE:	+	BENTONITE-CEMENT	
GPM FROM	<i>1</i> 6			SEAL OR 8-SACK CEMENT-SAND	
OTAL WATER REMOVED JURING DEVELOPMENT:		GALLONS		SEAL TO Test	
SESCRIPTION DELEA	ÙR. □SLI	GHTLY CLOUDY		BENTONITE PELLET	
AT END OF DEVELOPMENT:	. TURBID 🔲 VEI	RY MUDDY		SEAL /	
SDON OF /	` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` `			(0:0 4 1000 EU/	
MATER: / GROUND	SURFACE TANK T	BUCK	•+	SAND PACY	
TO: STORM S				10 25.25 1801	
DRUMS	OTHER			1NCH DIAMETE	
DEPTH TO WATER		FEET	*	SLOTTED (0.006	
MATERIALS USED				8.35 to 23.25	
	,			Z INCH DIAMETER	
SACKS OF	02400 20/4c	SAND		SCHEDULE 40 PVC BLANK SILT TRAP	
SACKS OF		CEMENT		23. 25 to LS.25 leet	
GALLONS OF GRO	OUT USED		<u></u>	BOTTOM WELL CAP	
SACKS OF POWD	ERED BENTONITE			25.25 leen	
50 POUNDS OF BENT	CONITESELLETS			HOLE CLEANED OUT	
8.2 FEET OF 2 IN	ICH PVC BLANK CASING	i		25.25 free	
14.9 FEET OF TIN	CH PVC-SECTEFO SCRE	EN.	<u></u>	BOTTOM OF BOREHOL	
YARO CEMENTS	ANG INCOMIXI ORBEI	RED	NOT TO SCAL	Ε _	
	SAND (REDI-MIX) USED	-	ADDITIONAL	INFORMATION:	
CONCRETE PUMPER USED?	NO TYES		Materials	pulled; well	
NAME			greated	to the surface	
WELL COVER USED: LOCA	CING STEEL COVER (N	115/5 EST Q3571 END		1	
івно́П Потні	STY BOX				
LOIM	SF1				



FIELD WELL COMPLETION FORM	CHRISTY BOX
NAME: EAKER AFB	LOCKING STEEL COVER
NOB PROJECT GVG	STEEL CONDUCTOR CASING
LOGGED URE EDITED BEN	
WELL EITWILL DATE: 12/16/91	INCH DIAMETER
DRILLING A. W POOL	
EQUIPMENT: CILY INCH HOLLOW STEM AUGER DRILLER:	BENTONITE CEMENT
HOURS	SEAL OR 8 SACK CEMENT-SAND
GALLONS OF WATER	IIII SEAL -
METHOD OF DECONTAMINATION	
PRIOR TO DRILLING: STEAM CIEANED	TOP OF CASING AT
DEVELOPMENT SEE WELL SEVEROPMENT FORM	GELOW GROUND LEVEL
METHOD OF DEVELOPMENT:	SOREHOLE
DEVELOPMENT BEGAN DATE: TIME:	0:0 24 leet
YIELDI TIME: DATE:	2 INCH DIAMETER
YIELD: TIME: DAPE:	SCHEDULE 40 PVC BLANK CASING
YIELD: TIME: DATE:	-10-1 to 6.2 feet
YIELD: TIME: DATE:	SEAL OR
TOTAL WATER REMOVED	8-SACK CEMENT-SAND
DURING DEVELOPMENT: GALLONS DESCRIPTION	2 to C.S feer
THE COPY COUNTY CLOUDY CONTROL OF THE CONTROL OF TH	BENTONITE PELLET SEAL #
ODOR OF OP	2 :0 4 'eet
WATER:	SAND PACK
TO: USTORM SEWERS USTORAGE TANK	13 18 100 18 1001
ORUMS OTHER	2 INCH DIAMETER
DEPTH TOWATER AFTER DEVELOPMENT: FEET	SLOTTED 1 0.006
MATERIALS USED	6.2 :016.4 tout
2 SACKS OF Colorado Silica 20/10 SAND	INCH DIAMETER
SACKS OFCEMENT	Sol On BLANK SILT TRAP
CEMENT/BENTONITE BENTONITE	io io leer
SACKS OF POWDERED BENTONITE SEA	100
1 60 POUNDS OF BENTONITE PELLETS	HOLE CLEANED OUT TO
6.1 FEET OF 2 INCH PVC BLANK CASING	CAJETIN 22 1981
10.2 FEET OF 2 INCH PVC SLOTTED SCREEN	BOTTOM OF BOREHOLE
2.00	
YARD CEMENT SAND (REDI-MIX) ORDERED	NOT TO STATE X ALSO ,
YARDI CEMENT-SANO (REDI-MIX) USED	ADDITIONAL INFORMATION:
CONCRETE PUMPER USED? NO DYES	S EAL From 18-22'
NAME	
WELL COVER USED: XLOCKING STEEL COVER CHRISTY BOX	
OTHER	



EIELD WELL COMPLETION FOR		
FIELD WELL COMPLETION FOR	M	CHRISTY BOX
NAME: EAKER AFR		LOCKING STEEL COVER
JOB 2 PRO	AGER: GUG	INCH DIAMETER STEEL CONDUCTOR
LOGGED USE EDIT	000	CASING
WELL EUTWIUS	12/16/91	— to — feet — INCH DIAMETER
DRILLING COMPANY: A.W. POOL	12/16/91	BOREHOLE
	DRILLER:	
G 1/4 INCH HOLLOWS		BENTONITE-CEMENT SEAL OR
GALLONS OF WATER	ASH ORILLED: 1.0	B-SACK CEMENT SAND
METHOD OF DECONTAMINATION	GALLONS	tofeet
HOW TO DRILLING: HOW	buerence rem	TOP OF CASING AT
DEVELOPMENT SEE DEVELOPME	ENT FORM	9ELOW GROUND LEVEL
METHOD OF DEVELOPMENT:		674 INCH DIAMETER
DEVELOPMENT BEGAN DATE: TIME	· ·	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
TIME: GPM FROM TO	DATE:	-0.1 to 1001
TIME: GPM FROM TO	DATE	SCHEDULE 40 PVC
YIELD: TIME:	DATE:	BLANK CASING -6.1 to 6.2 feet
VIELD: TIMEL	DATE:	SENTONITE-CEMENT
GPM FROM TO		SEAL OR B-SACK CEMENT-SAND
DESCRIPTION	GALLONS	SEAL ~C.S, o 2 feer
OF TURBIDITY DELEAR AT END OF DEVELOPMENT:	SLIGHTLY CLOUDY	BENTONITE PELLET
ODOR OF	VERY MUDDY	SEAL *
WATER:		GOLDANDO SILIEN DOJ40
OISCHARGED GROUND SURFACE USTORM SEWERS	TANK TRUCK	SANO PACK
DRUMS	STORAGE TANK OTHER	10 10 1001
DEPTH TO WATER AFTER DEVELOPMENT:	FEET	SLOTTED 1 0.00 6
MATERIALS USED		inch SCREEN 6.2 to 16.3 igus
SACKS OF COLONGOD S	50/	2 INCH DIAMETER
		SCUEDIU CARRIETEN
SACKS OF GROUT USED	CEMENT	BLANK SILT TRAP
SACKS OF POWDERED BENTO		BOTTOM WELL CAP
POUNDS OF BENTONITE PELL		
6.15 FEET OF 2 INCH PVC BLAN		HOLE CLEANED OUT TO
10.1 FEET OF 2 INCH PVC SLOT		21 1700
	HONCKEEN	BOTTOM OF BOREHOLE
YARO ³ CEMENT-SAND (REDI-M		
YARD CEMENT-SAND (REDI-A	IIX) USED	
CONCRETE BUMBER AND THE	YES	PELLETS 18-21 TO SEAL
NAME		
WELL COVER USED: ALOCKING STEEL C	OVER	_ CFF LOWER WATER ZONE
CHRISTY BOX		



						CHRISTY BOX
						A LOCKING STEEL COVE
	EAKER AFB	PROJECT		41-5	┑ ┋	TINCH DIAMETER
NUMBER:	3K98	MANAGER:	606			CASING
OGGED Y:	LRE	SA:	BEN			
WELL HAME:	EHTWIG	TWILL	12/14/91			BOREHOLE
DRILLING					1 11	to feet
COUIPMENT	F: 57 6 1/4 INCH W	OLLOW STEM ALI	GER V.B. CAZZC		-	BENTONITE-CEMENT
		OTARY WASH	HOURS ORILLED: 0.5	·		- 8 SACK CEMENT-SANI SEAL
SALLONS C	F WATER			-		
	P DECONTAMINATION		GALLONS	Ç	-	
PRIOR TO E	MILLIMO: 1-TE	GH PRESSU	LE STEAM			TOP OF CASING AT
DEVELOP	MENT	·				(BELOW)GROUND LEV
METHOD O DEVELOPM						BOREHOLE
DEVELOPM		TIME:				O :0 22 1001
YIELDI	GPM FROM	то	DATE:		-	- 2 INCH DIAMETE
YIELDI	TIME:	то	DATE:			BLANK CASING
YIELD:	TIME:		OATE			0, 2 to 7, 4 feet
YIELD:	GPM FROM	TO	DATE		•	SEAL OR
TOTA: WA	GPM FROM TER REMOVED	то			1	- B SACK CEMENT SAN
DURING DI	EVELOPMENT:		GALLONS			5.5 .0.0 .5 feer
DESCRIPTI OF TURBLE AT END OF	CLEAR	, (SLIGHTLY CLOUDY		—	BENTONITE PELLET
DEVELOP		TURBID [VERY MUDDY			7 :0 5.5 en
ODOR OF					_ • -	CONTROL SILICA
WATER	GROUND S		ANK TRUCK		Ξ;	SAND PACK
TQ:	☐STORM SE		TORAGE TANK			- 2 INCH DIAMET
DEPTH TO	WATER		FEET		=:	SLOTTED 1 0.00
	VELOPMENT:		FEET		=	7.9 to 18 C feet
MATERIA	ala USEU				1	
			•			2
3	_ SACKS OF _ZO14 (s Coloanou	SILL CA SAND			- 2 INCH DIAMET
3	_ SACKS OFSACKS OF		SILLCA SAND			
	SACKS OF			(x)		2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 1001 BOTTOM WELL CAP
	SACKS OF	UTUSED (८७५	CEMENT LEWT / BENTOW TE M	(x)		2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 1001
	SACKS OF _ GALLONS OF GRO	UT USED (ರಘು RED BENTONITE	CEMENT LEWT / BENTOW TE M	(x)		2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 to 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU
4 25	SACKS OF GROUND OF GROUND SACKS OF POWDER	UT USED (८७० RED BENTONITE DNITE PELLETS	CEMENT BENTONITE M ASING			2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 to 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU 22 feet
4 25	SACKS OF GALLONS OF GROWN SACKS OF POWDER POUNDS OF BENTO INC	UT USED (८७० RED BENTONITE DNITE PELLETS	CEMENT LEWIT / BENTOWITE M			2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 to 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU
4 25	SACKS OF GALLONS OF GROWN SACKS OF POWDER POUNDS OF BENTO INC	UT USED (८७०) RED BENTONITE DNITE PELLETS CH PVC BLANK CA	CEMENT BENTONITE M ASING			2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 to 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU 22 feet
4 25	SACKS OF GALLONS OF GROWN SACKS OF POWDER POUNDS OF BENTO INC	UT USED (CEAL RED BENTONITE DNITE PELLETS CH PVC BLANK CA	CEMENT SENTONITE M ASING 2.3' COLUMN 3.31 COLUMN		O SCALE	2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU 22 feet BOTTOM OF BOREH
4 25	SACKS OF GALLONS OF GROW SACKS OF POWDER POUNDS OF BENTO FEET OF INC FEET OF INC	UT USED (COA RED BENTONITE DNITE PELLETS CH PVC BLANK CA	CEMENT SENTONITE M ASING DADERED	NOTT	•	2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU 22 feet BOTTOM OF BOREH
25 10 101	SACKS OF GALLONS OF GROWN SACKS OF POWDER POUNDS OF BENTO FEET OF INC FEET DF INC FEET DF INC YARD CEMENTS	UT USED (COAL RED BENTONITE DNITE PELLETS CH PVC BLANK CA	CEMENT SENTONITE M ASING DADERED	NOT T ADDIT	rionali	2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 1001 BOTTOM WELL CAP 20 1001 HOLE CLEANED OU 22 1001 BOTTOM OF BOREH NFORMATION:
25 10	SACKS OF SACKS OF GALLONS OF GROW SACKS OF POWDER POUNDS OF BENTO FEET OF INC FEET OF	UT USED (COA RED BENTONITE DNITE PELLETS CH PVC BLANK CA PVC BLANK CA AND TREDIMIX) C	CEMENT SENTONITE M ASING DADERED	NOT T ADDIT	rionali	2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 feet BOTTOM WELL CAP 20 feet HOLE CLEANED OU 22 feet BOTTOM OF ROBEH
25 1c 1c CONCRET	SACKS OF SACKS OF GALLONS OF GROW SACKS OF POWDER POUNDS OF BENTO FEET OF INC FEET OF	TOUSED (COME PED BENTONITE DINITE PELLETS CH PVC BLANK CAME PVC BLANK CAME PVC BLANK CAME PVC BLANK CAME PVC BLANK CAME PVC BLANK CAME PVC BLANK CAME PVC BLANK PVC BL	CEMENT ASING 2.3' DADERED	NOT T ADDIT Sco	rional i	2 INCH DIAMET SCHEDULE 40 PVC BLANK SILT TRAP 18 10 20 1001 BOTTOM WELL CAP 20 1001 HOLE CLEANED OU 22 1001 BOTTOM OF BOREH NFORMATION:



FIELD WELL COMPLETI	ON FORM			CHRISTY BOX
IOD EAKER AL				LOCKING STEEL COVE
NUMBER: 3K98	lanau	V C-	4	STEEL CONDUCTOR
OGGED IRE	EDITED BF			CASING
WELL EII- TWI		DATE: 12/17/4		INCH DIAMETER
ORILLING		12/11/	'	BOREHOLE
COLLEGE TO A LA	HOLLOW STEM AUGER	DRILLER:		BENTONITE CEMENT
_	ROTARY WASH	HOURS DRILLED:		SEAL OR 8-SACK CEMENT-SAND SEAL
GALLONS OF WATER	NONE	GALLONS		
METHOD OF DECONTAMINATION TO DRILLING:	PRESSURE STE	2904		TOP OF CASING AT
	TL DEVELOPM			O 2 FEET ABOVE AT
METHOD OF DEVELOPMENT:				BELOW GROUND LEVE
DEVELOPMENT BEGAN DATE:	TIME:	/.		BOREHOLE 0 to 22
YIELD: TIME:	то	DATE:		JIS O D INCH DIAMETER
TIELD: TIME:	то	DATE:		BLANK CASING
TIELD: TIME:	10	DATE:		0.2 to 5 feet
GPM FROM	то	DATE:		SEAL OR
OTAL WATER REMOVED		GALLONS		8-SACK CEMENT-SAND
DESCRIPTION CLEA		GHTLY CLOUDY	XXX	2 .0 0.5 feer
AT END OF		RY MUDDY		BENTONITE PELLET
DOR OF NATER:			3333 	2 :0 3 'eet co co co co co co co co co co co co co
MATER GROUND		RUCK		SAND PACK_
STORM SI	EWERS STORA			3 10 17 1001
DEPTH TO WATER		FEET		2 INCH DIAMETE
MATERIALS USED				15 to 5 ieur
3 excreps Cou	GAADO SILICA E	20/40		2 INCH DIAMETER
SACKS OF		CEMENT		BLANK SILT TRAP
	NT USED (LEMENT)			15 to 17 lest
SACKS OF POWDE	•	BENTON	SITE S	BOTTOM WELL CAP
2.5 POUNDS OF BENT		SEAL		HOLE CLEANED OUT T
	CH PVC BLANK CASING			20 feet
IO.O FEETOE Z INC	HAVE SLOTTED SCREE	N		BOTTOM OF BOREHOL
3-		The second secon	Proceedings of the second	
	AND (BEDI-MIX) DROEF AND (REDI-MIX) USED	RED	NOT TO	SCALE
			ADDITIO	NAL INFORMATION:
NAME	MO DAE2			
WELL COVER USED: XLOCK	NG STEEL COVER			
Псняіз Потнеі	TY BOX			



FIELD WELL COMPLETION FORM	CHRISTY SOX	
100 FOUCO OCO BY (1) - (1)	LOCKING STEEL COVE	
MAME: EAKER AFB BY Shopeffe	STEEL CONDUCTOR	
EDITED		
(DATE:	GORENOLE DIAMETER	
NAME: 1W1120 11-7-92	BOREHOLE O to 30 feet	
COMPANY: AW POOL		
EQUIPMENT: WHILL INCH HOLLOW STEM AUGER V. 150RAZZA	BENTONITE-CEMENT SEAL OR	
INCH ROTARY WASH DRILLED: . 88	B-SACK CEMENT-SAND	
GALLONS OF WATER DONE GALLONS		
METHOD OF DECONTAMINATION PRESSURE STEAM	Note: STICK DOWN NO.Z	
DEVELOPMENT SEE WELL DEVELOPMENT FORM	BELOW GROUND LEVE	
METHOD OF DEVELOPMENT:	BOREHOLE	
DETELOPMENT TIME:	0 to 30 test	
YIELD TIME! TO GATE:	ZINCH DIAMETER	
TIELDI TIMEI DATEI	SCHEDULE 40 PVC BLANK CASING	
TO TIME! DATE!	2.8 10 17.2 feet	
GPM FROM TO	SEAL OR	
GPM FROM TO	8-SACK CEMENT-SAND	
DURING DEVELOPMENT: GALLONS	SEAL 0.5 15 1887	
OF TURBUNY CLOUDY	BENTONITE PELLET	
DEVELOPMENT: MOD. TUREID VERY MUDDY	SEAL 15 :0 16 'get	
SDOR OF WATER!	CELORADO SILICA	
WATER DISCHARGED GROUND SURFACE GIANK TRUCK	SAND PACK ZOLYO	
TO: OSTORM SEWERS OSTORAGE TANK	30 10 16 1set	
DEPTH TO WATER	SLOTTED 10.006	
AFTER DEVELOPMENT: FEET	men · SCREEN	
MATERIALS USED	17.2:027.2 teet	
Z 100# SACKS OF COLORADE SINIA 20/40 SAND	2 INCH DIAMETER	
SACKS OF TORTIAND TUPE TE CEMENT	BLANK SILT TRAP	
GALLONS OF GROUT USED		
SACKS OF POWDERED BENTONITE	GOTTOM WELL CAP	
SO POUNDS OF BENTONITE PELLETS	HOLE CLEANED OUT TO	
20 FEET OF VINCH PVC BLANK CASING	30 1-11	
THE PROOF THE PROPERTY OF THE		
2 PEST OF 2 INCH PUC SUMP.	m	
YARD CEMENT-SAND (REDI-MIX) ORDERED	NOT TO SCALE	
YARD CEMENT-SAND (REDI-MIX) USED		
	WELL PAS WAS CONSTRUCTED	
NAME	1/9/92 - cur or ~35' of	
WELL COVER USED: XLOCKING STEEL COVER	_ 	
CHRISTY BOX	RSOK PIPE, CAPLETED WELL	
Потнея	A: M.154	



FIELD WELL COMPLETION FORM				CHRISTY BOX
400 / A A CO				LOCKING STEEL COVER
NAME: PANEL A PB			4-1-1-1	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGED	COITED HE			10
WELL BAH	104: A-C	TOATE LAS		INCH DIAMETER
MAME: MW1)21		4/8/95		BOREHOLE
COMPANY: Ju-State	Testing			BENTONITE-CEMENT
	LOW STEM AUGE	MOURS DRILLED:		SEAL OR B SACK CEMENT SAND SEAL
GALLONS OF WAYER USED DURING DRILLING:	<u>†</u>	GALLONS		tofeet
METHOD OF DECONTAMINATION PRIOR TO DRILLING:		mer		TOP OF CASING AT
		MENT FORM		PER ABOVE AT
METHOD OF DEVELOPMENT:			1	AORENOLE DIAMETER
DEVELOPMENT BEGAN DATE:	TIME:			80REHOLE 0 :0 16.7 1881
GPM FROM	TO	DATE:	-	2 INCH DIAMETER
VIELD: TIME:	то	DATE		SCHEDULE 40 PVC BLANK CASING
YIKLO: TIME:		DATE:		+ 2.4 10 4.2 lees
GPM FROM	TO	DATE	-	SEAL OF
GPM FROM	TO		-	8-SACK CEMENT-SAND
DURING DEVELOPMENT:		GALLONS		D-ro_LDfeer
OF TURBIDITY CLEAR AT END OF DEVELOPMENT: MOD. TU		LIGHTLY CLOUDY ERY MUDDY		BENTONITE PELLET SEAL 1,0:0 3.0 (set
ODOR OF WATER:				20/40 MORIESILLA
WATER GROUND SUI	RFACE TANK	CTRUCK		SAND PACK
STORM SEWS		AGE TANK		3.0 0/6.7 feer
DEPTH TO WATER	□отн			SLOTED (D.D)
MATERIALS USED		FEET		inch: SCREEN U. 2 to 17.2 feet
	all alum O	4	-	2 INCH DIAMETER
SACKS OF5				BLANK SILT TRAP
SACKS OF		CEMENT	1 1 1	14.2 to 16.2 tens
GALLONS OF GROUT				BOTTOM WELL CAP
75 POUNDS OF BENTON				HOLE CLEANED OUT TO
18/4) 4.95		,		16.7 Get
10.0 FEET OF 2 INCH!	5.5. WESLOTTED SCA	ro REEN		BOTTOM OF BOREHOLE
YARD3 CEMENT-SANI	C (REDIANIX) ORD	FRED	NOT TO SCA	LE
YARD ³ CEMENT-SAN			ADDITIONA	LINFORMATION:
CONCRETE PUMPER USED?				
WELL COVER USED: LOCKING CHRISTY COTHER				
E O I MEN				



FIELD WELL COMPLETION	N FORM	•		_	CHRISTY BOX
					LOCKING STEEL COVER
inne: leakn AFB			41-5-	7-14	STEEL CONDUCTOR
OH HUMBER: DILY		A Tentus			CASINGteet
OGGEO BDH	EDITED - FR	Ellis			- INCH DIAMETER
MELL MW1122		4/7/95		11	BOREHOLE
20111110	Jostin				(O feet
102		IR DRILLET leaser	.		BENTONITE CEMENT
	OTARY WASH	HOURS OU	11 1	I	B SACK CEMENT SAND
	A	GALLONS			101441
METHOD OF DECONTAMINATION PRIOR TO DRILLING:				74	TOP OF CASING AT
DEVELOPMENT SES		wormant Form		2.	FEET ABOVE AT
METHOD OF				-	— 10 其 INCH DIAMETER
DEVELOPMENT:			1		BOREHOLE
DEVELOPMENT BEGAN DAYE: VIELD: TIME:	TIME:	DAYE			- 2 INCH DIAMETER
GPM FROM	TO	DAYE:			SCHEDULE 40 PVC BLANK CASING
GPAL FROM	TO	DATE:			+ 2.5 to 511 feet
GPM FROM	TO	DATE		1-+-	SEAL OR
GPM FROM	το	BATE.		- -	SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS			SEAL 70 2.0 fear
DESCRIPTION OF TURBIDITY DELEAR	a D	SLIGHTLY CLOUDY		** —	BENTONITE PELLET
AT END OF DEVELOPMENT; MOD.	TURBIQ	VERY MUDDY			2.0 10 4.0 Test
ODOR OF WATER;			1 L		20/40 MORE SILLE
WATER GROUNDS	= \	K TRUCK			SAND PACK 4. D to 17.9 1001
TO: STORM SE	øfe□ eraw: HTO□	RAGE TANK			
DEPTH TO WATER		FEEDLE	:		SLOTTED (D. D.)
AFTER DEVELOPMENT		PREV -			Sil to 15.1 feet
MATERIALS USED		-4 :-	1 +		
11.5 SACKS OF	55010 kg, 201	40 MOTE SAND			BLANK SILT TRAP
SACKS OF		CEMENT			15.1 10/7.3 leet
GALLONS OF GRO		- M	ا ا		BOT 'GM WELL CAP
SACKS OF POWDER		,			
75 POUNDS OF BENTO	ONITE PELLETS				7.9 leet
8.3 FEET OF 2 INC	S.S.	ING	<u> </u>		BOT OM OF BOREHO
10.0 FEET OF 1 INC 2.2 Feet of 2 in	ich sis sitt t	trop			<u>17. 9</u> toet
YARD3 CEMENT-SA				TO SCALE	
YARD3 CEMENT-S	AND (REDI-MIX) US	iED	ADD	HTIONAL II	NFORMATION:
CONCRETE PUMPER USED?	_				
NAME			·		
WELL COVER USED: LOCKI					

FIELD WELL COMPLETION FORM		CHRISTY BOX	
NAME: Eaber AFB		LOCKING STEE	
NUMBERS OSCH PROJECT ALLO	in Jerkins	STEEL CONDUC	
LOGGED G. Millar BUTED IN E	llin		iees
MAME: MW1123	8111195	BOREHOLE	METER
company Tri State Testing Servi	ces		oet
MCH HOLLOW STEM AUGER	Crawford	BENTONITE CENSEAL OR	
GALLONS OF WATER USED DURING DEILLINGS 7 GA	LLONS for draction	101	465
PRIOR TO DRILLING: SHOW CLEO		700.05.01000	
DEVELOPMENT See Well Developmen	# Form	TOP OF CASING	VE AT
METHOD OF DEVELOPMENT:		BELOW CHOURD	TLEVEL
DEVELOPMENT SEGANDATE: TIME:	0	BOREHOLE	
	TE	0:019:51	
GPM FROM TO	TE:	SCHEDULE 40 PV	AETER C
CPM FROM TO	TE:	BLANK CASING O to 19-61	ec:
GPM FROM TO	TE:	DENTONITE CEM	ENT
OTAL WATER REMOVED		SEAL OR	SAND
ESCRIPTION	LONS	SEAL 0 10 310 (E	.
OEVELOPMENT:	LY CLOUDY	BENTONITE PELL	ET
MOD. TURBIO VERY N	AUDDY	SEAL 3.0 10.5.0 10	. 1
VATER DOOLING CORE		Marie 2014	lo
OSTORM SEWERS DSTORAGE TO		SAND PACK 5.0 10 19.5 (e)	.,
DRUMS DOTHER		2 INCH DIAM	
FTEN DEVELOPMENT: FEET	•	SLOTTED (.O	!
12.0 062495 000 GA CON WELL	The .	7.50 to 17.60 fee	٠,
His orm SACKS OF Morie 20140 Filtration 1	redigano	A NCH QUAL	ETER
SACKS OF		SCHEDULE 40 PVI BLANK SILT TRA	P
GALLONS OF GROUT USED	•	17.50 (9:50) N	
SACKS OF POWDERED BENTONITE &		BOTTOM WELL CA	tofsla
POUNDS OF BENTONITE PELLETS 1 /Z	buckets	HOLE CLEANED O	<u> </u>
FEET OF INCH PVC BLANK CASING		19.5	
10 FEET OF 2 INCH ASSIS SI IT TOP.		BOTTOM OF BORE	HOLE
YARD ³ CEMENT-SAND (REDI-MIX) ORDERED	1	NOT TO SCALE	1
YARD CEMENT-SAND (REDI-MIX) USED		ADDITIONAL INFORMATION:	
ONCRETE PUMPER USEDT ON O TYES		Calcusated Send = 11,31 5	AUKS
IME grow mixed in 55 gal dr		Calculated grout = 11.76	
ELL COVER USED: TOLOCKING STEEL COVER CHRISTY BOX OTHER		J. 10. 16	
			- 1

FIELD WELL COMPLETIO	N FORM	•		CHRISTY BOX
HAME: Eaker AF	A			LOCKING STEEL COVE
IOS NUMBER: 0114	PROJECT	llan Tenkins	41-5	INCH DIAMETER STEEL CONDUCTOR CASING
LOGGEO G. Millor	FOITED	3		ioleet
HAME: MW1124		8112195		NCH DIAMETER
COMPANYITTI State Tes	ting serv	ices		
EQUIPMENT:	LLOW STEM AUGER	DELL CO.		BENTONITE-CEMENT
INCH RO	TARY WASH	HOURS DRILLED:		BSACK CEMENTSAND
GALLONS OF WATER USED DURING DRILLING:	50	GALLONS		10feet
PRIOR TO DRILLING: Stea	m clean	ina		TOP OF CASING AT
DEVELOPMENT See WA		prient form		1.65 FEET ABOVE AT
METHOD OF DEVELOPMENT:				10 INCH DIEMETER
DEVELOPMENT BEGAN DATE;	TIME			BOREHOLE O to 38 feet
GPM FROM	70	DATE:		2 INCH DIAMETER
TIME:	то	DATE:		SCHEDULE 40 PVC BLANK CASING
YIELD: TIME: GPM FROM	то	DATE:		0 10 26 lest
YIELD: TIME:	то	DATE:		SEAL OR
TOTAL WATER REMOVED DURING DEVELOPMENT:		GALLONS		5-SACK CEMENT-SAND
DESCRIPTION OF TURBIDITY DCLEAR	_	GHTLY CLOUDY	8888	
AT END OF DEVELOPMENT: MOD. TUI		RY MUDDY		BENTONITE PELLET SEAL
GDOR OF WATER:				22 to 24 reet
WATER DISCHARGED DGROUND SUR		RUCK		Movie 20/40 [mane] SAND PACK
TO: OSTORM SEWER		•		241038 lees
DEPTH TO WATCH AFTER DEVELOPMENT:	OTHER,	•		2 INCH DIAMETER
MATERIALS USED		EET		SLOTTED (_O.O/O
200	495 CAOOL	wece.		26 to 36 feet
121/2 SACKS OF Morie 2	6/40 Filtratio	ONAZITODINO		SCHEDULE 40 PHE SS
SACKS OF ン 65 GALLONS OF GROUT U		CEMENT		BLANK SILT TRAP
SACKS OF POWDERED	•			BOTTOM WELL CAP
50 POUNDS OF BENTONIT	BENTONITE	NAM also also		38 leer
30 FEET OF 2 INCHES	CRIANK CATING	2 Foet or Cut		HOLE CLEANED OUT TO
30 FEET OF 2 INCH PU	タ うにひょうというじょうちょ	•		BOTTOM OF BOREHOLE
a Fr of 2 inch	se silt tre	مه		38 Ices
YARD ³ CEMENT-SAND (REDI-MIXI ORDERE	. ·	NOT TO SC	ALE
YARD CEMENT-SAND		ŧ	ADDITION	AL INFORMATION:
CONCRETE PUMPER USED?	TYES	de un		ated Sand 10.93 Sack
VELL COVER USED: LOCKING ST		www.	Calous	aled grout 86.24 gas.
CHRISTY BO	X			<u> </u>
OTHER				

FIELD WELL COMPLETION	CHRISTY BOX	
HAME: Eaker AFB		LOCKING STEEL COVER
JOB NUMBER: 0114	MANAGER: Allan Jenki	STEEL CONDUCTOR
LOGGED G. Millar	EDITEO JE Ellis	tofeet
WELL MW1125	10/3/19	INCH DIAMETER
ORILLING	stina Services	BOREHOLE (ce)
EQUIPMENT: \$714 INCH HOL	DRILLERI	BENTONITE CEMENT
_	ARY WASH DRILLED:	SEAL OR B-SACK CEMENT-SAND SEAL
GALLONS OF WATER USED DURING DRILLING	70 GALLONS	tofeet
METHOD OF DECONTAMINATION PRIOR TO DRILLING:	team Cleaning	TOP OF CASING AT
DEVELOPMENT See Well	Development For	2.9 ZEFEET ABOVE AT
METHOD OF DEVELOPMENT:		BELOW GROUND LEVEL
DEVELOPMENT BEGAN DATE:	Min A A II -	BOREHOLE
YIELD: TIME!	TIME: DATE:	
YIELD: TIME:	TO DATE:	SCHEDULE 40 PVC
TIELD: TIME:	OATE:	BLANK CASING + 2.5 to 26 feet
GPM FROM 1	OATE:	A BENTONITE-CEMENT
GPM FROM T	<u>o</u>	SEAL OR BSACK CEMENT SAND
TOTAL WATER REMOVED DURING DEVELOPMENT:	GALLONS	SEAL 0 22 (set
DESCRIPTION DE TURBIDITY AT END OF	SLIGHTLY CLOUDY	
PEYELOPMENT: MOD, TUR	BID VERY MUDDY	SEAL .
DOOR OF NATER:		32 :0 24 reci
GROUND SURF		SAND PACK
GSTORM SEWER	S STORAGE TANK	24 10 38 feet
EPTH TO WATER FTER DEVCLOPMENT:	FEET LEV	SLOTTED (0,010
AATERIALS USED	LEE! AM	inch SCREEN S.S.
20.005	GAONNELL	26 to 36 feet
	to Altrationmodia sano	SCHEDULE 40 PVE S.S.
SACKS OF	CEMEN	BLANK SILT TRAP
GALLONS OF GROUT US	,	BOTTOM WELL CAP
SACKS OF POWDERED 8		38 her
	PELLETS 144 bucket	
30 FEET OF 2 INCH PVC	BLANK CASING 1.5ft CL	
10 FEET OF 2 INCHES		80TTOM OF BOREHOLE
YARD CEMENT SAND (R	•	*
YARD CEMENT SAND (R		NOT TO SCALE
ONCRETE PUMPER USED? ONO		ADDITIONAL INFORMATION:
AME MA	CXA62	Calculated Sand=10.9250
ELL COVER USED: XLOCKING STI	K	calculated grout- 50:360
Потнея		
	•.	

FIELD WELL COMPLETION FORM	CHRISTY BOX
HAME: FORW AFB	C LOCKING STEEL COVE
100	STEEL CONDUCTOR
LOGGED FOITED	CASING
GI MITTAY Jan	10[eet
NAME: MW1126 1101/95	BOREHOLE
CONFANY Tri-State Testing Services	
1 741 INCH HOLLOW STEM AUGER J. Crawford	BENTONITE-CEMENT
INCH ROTARY WASH DRILLED:	SEAL CEMENTSAND
USED DURING DRILLING: 52 GALLONS PRESS	
PRIOR TO ORILLING: Steam Cleaning	
DEVELOPMENT See Well Development Form	TOP OF CASING AT
METHOD OF DEVELOPMENT:	BELOW GROUND LEVEL
DENETOWENT	BOREHOLE
TIME:	0 :0 41 leet
GPM FROM TO	2 INCH DIAMETER
GPM FROM TO	SCHEDULE 40 PVC BLANK CASING
GPM FROM TO	+2.510 29 feet
GPM FROM TO	SEAL OR
DURING DEVELOPMENT: GALLONS	6-SACK CEMENT-SAND
DESCRIPTION OF TURBUITY TICLER	O 10 22 (ect
DEVELOPMENT: DMOD. TURBID DVERY MUDDY	BENTONITE PELLET
ODON OF WATER:	22, 24, 100
MATER DESCHARGED DEROUND SURFACE TANK TRUCK	Movie 20HO(con)
TO: DETORM SEWERS DETORAGE TANK	SAND PACK 27104/ Iggs
DEPTH TO WATER	2 INCH DIAMETER
AFTER GEVELOPMENT: FORTAL	SLOTTED (0.0/0)
MATERIALS USED	irch · SCREEN 29 to 39 feet
91/2 SACKS OF MOVIE 20HO FI Hration Media.	2 INCH DIAMETED
SACKS OFCEMENT	SCHEOULE 40 PVE ST
GALLONS OF GROUT USED	39 10 41 leet
SACKS OF POWDERED BENTONITE	BOTTOM WELL CAP
50 POUNDS OF BENTONITE PELLETS I bucket	41 feet
FEET OF 2 INCH DVC BI ANY CASING 2 SCHOOL TOCK	HOLE CLEANED OUT TO
FEET OF A INCH PAG SI OTTED SCREEN	BOTTOM OF BOREHOLE
2 Frof 2 inch sis. Si It trap	41 less
YARD CEMENT SAND (REDI-MIX) ORDERED	NOT TO SCALE
YARD CEMENT-SAND (REDIMIX) USED	
CONCRETE PUMPER USED? ONO SYES	Calculated Sond=10.92 toop
NAME	
WELL COVER USED: LOCKING STEEL COVER	Calculated grout = 98-gals
Ochristy Box	
	• =

SURVDATA.XLS

SAMPLE LOCATION/ELEVATION EAKER AIR FORCE BASE, ARKANSAS

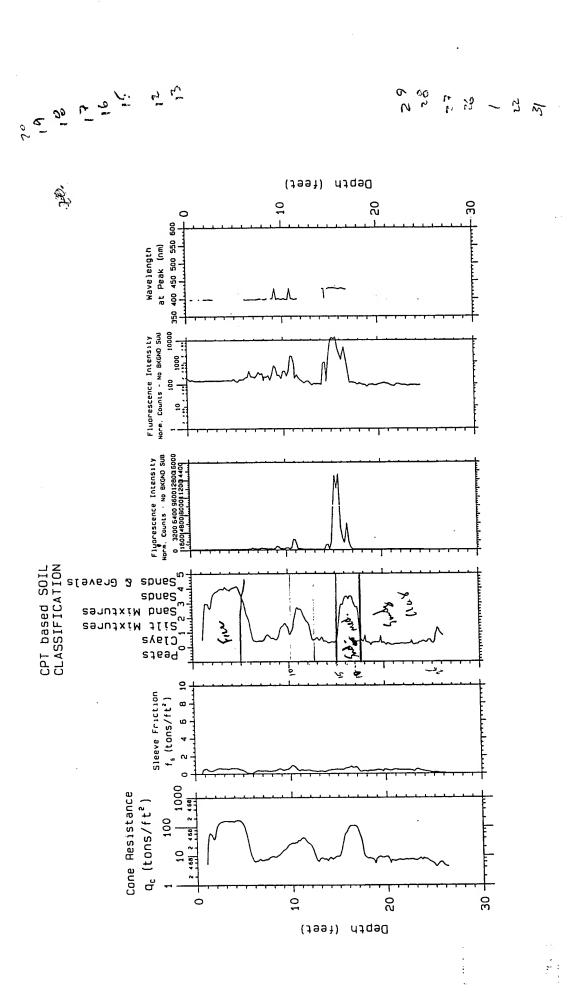
Sample	Elevation	Ground	Coordinates		Site
Point	TOC	Elevation	Northing	Easting	
TW1102	249.52		599301.20	2604930.49	RX
TW1103	249.99		599245.87	2605004.10	BX
MW1104	251.48		599380.79	2605116.02	BX
TW1105	251.14		599340.38	2604984_22	BX
TW1106	250.98		599356.10	2604925.65	BX
TW1107	251.31		599377.34	2605044.84	BX
TW1108	250.75		599297.47	2605018.95	BX
TW1 109	250.89		599269.70	2605047,84	BX
MW1110	251.23		599285.35	2605052.46	BX
MW1111	251.32		599445.92	2605047.22	BX
TW1112	250.86		599348.57	2605017.22	BX
TW1113	252.01		599449.00	2604918.04	BX
MWI114	251.64		599513.89	2604985.04	BX
MW1115	250.37		599355.32	2604845.78	BX
MW1116	250.62		599187.31	2604940.79	BX
TW1117	250.83		599261.14	2605070.50	EX
TW1118	250.42		599233.00	2605100.52	BX
MW1119	249.75		599198.81	2605113.49	BX
MW1120	251.73	•	599447.41	2604838.18	BX
MWI 121	253.16	250.97	599307.09	2605212.18	BX
MW1122	253.02	250.68	599488.98	2605029.14	BX
MW1123	253.56	251.13	599426.94	2604884.90	BX
MW1124	253.58	251.93	599440.75	2604894.57	BX
MW1125	253.48	280.58	599527. 42	2604778,54	BX
MWI 126	253.70	250.91	599313.88	2605207.14	BX
MW1127	Z60.54	250.76	519181-58	2604946.27	BX
MW1128	STIL	- Remai	110 et 3 min	よれべをかもか	BX
CP03		251.12	599361.54	2604978.20	BX
CP19					BX
CP22					BX
CP26		251.52	599356.27	2604925.70	BX
Bi		252.18	599386.58	2605029.03	BX
B2		251.96	599388.57	2605019.62	BX
B3		251.85	599388.65	2605008.02	BX
B4		251.75	599381.05	2604999.58	BX
B5		251.64	599373.17	2604995.29	BX
B6	+	251.77	599350.54	2604998.47	BX
87		250.97	599348.42	2605017.32	BX
38		250.98	599340.55	2605031.63	BX
B9		251.12	599347.35	2605041.38	ВX
B10		251.23	599354.04	2605048,24	BX
B11		251.26	59 9 361.16	2605055,91	BX
B12		251.56	599376.42	2605049,23	BX
B13		252.50	599393.30	2605039.89	BX

APPENDIX B - 1C

CPT/LIF OUTPUT

BX SHOPPETTE

Source: USACE 1995.



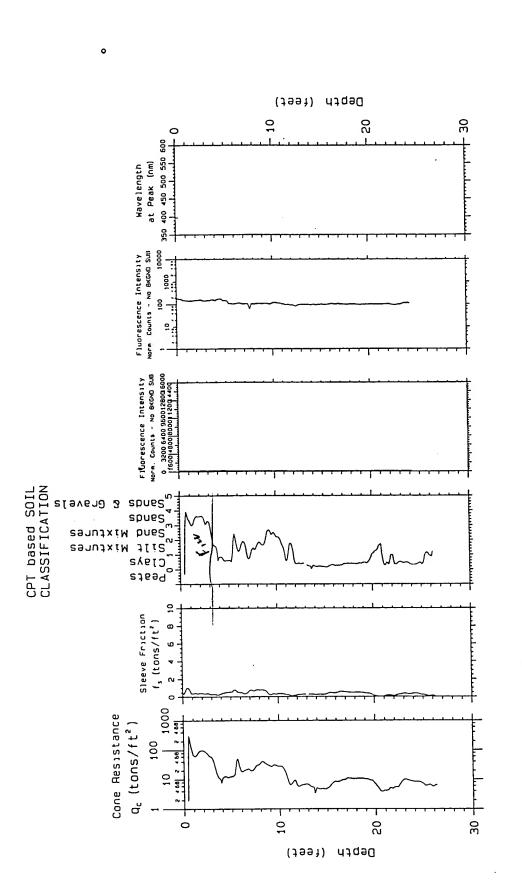
<NEW> 26.50 Probe Depth; Eaker AFB Project;

Site Characterization CPT; 01EAK01 Penetrometer System CPT;

Probing date; 03-24-1995

U.S. Army Engineer District Sansas City Geotechnical Branch

Laser induced
fluorescence
of POL via
fiber optics



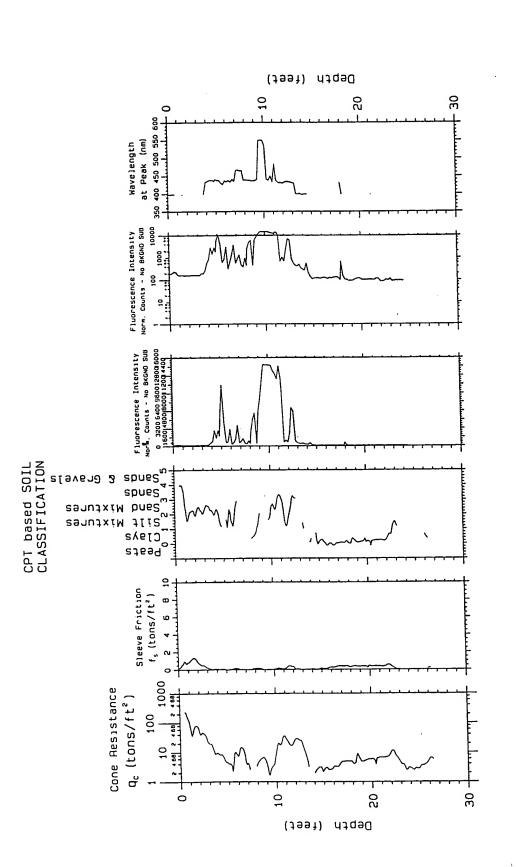
26.45 Eaker AFB Probe Depth; Project;

r; 2EAK01 Site Characterization and Analysis Penetrometer System

U.S.Army Engineer District Kansas Ci

Laser induced fluorescence of POL via fiber optics

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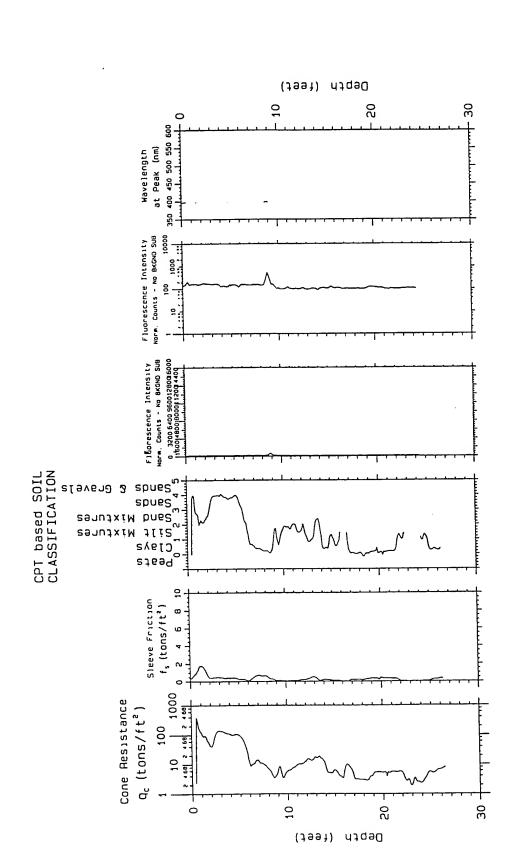
Eaker AFB 26.54 Probe Depth; Project;

Laser induced
fluorescence
of POL via
fluore optics

Site Characterization CPT. Band Analysis Penetrometer System

Probing date: 03-24-1995

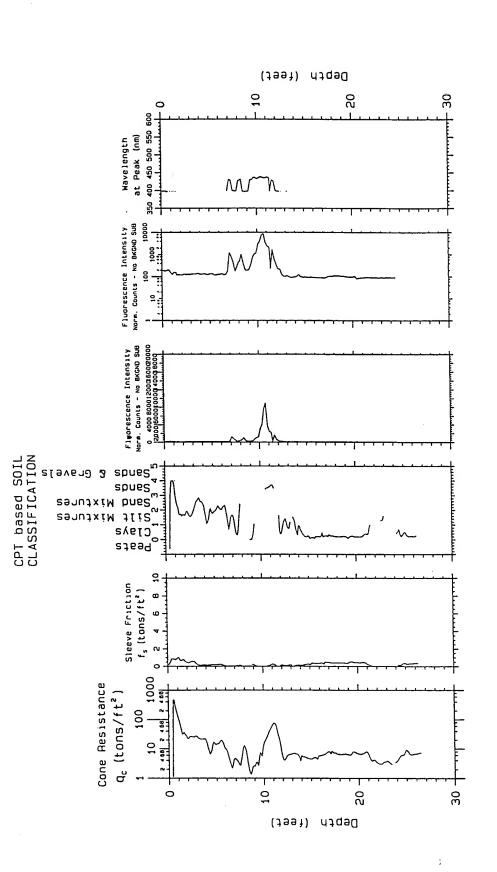
U.S.Army Enginear District Kansas City Geotechnical Branch



Eaker AFB 26.59 Probe Depth; Project;

CPT; 4EAK01 Site Characterization and Analysis Penetrometer System

Laser induced
fluorescence
of POL via
fiber optics



Eaker AFB 26.61 Probe Depth; Project;

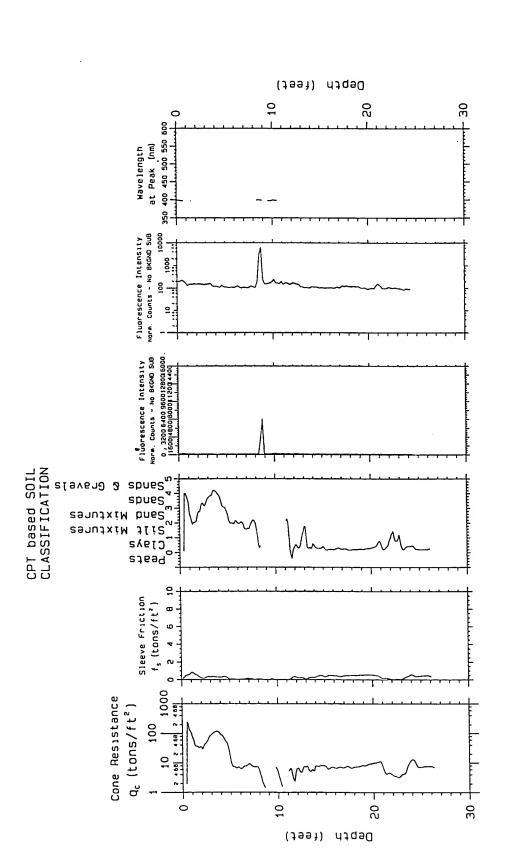
Site Characterization and Analysis Penetrometer System

Probing date; 03-24-1995

U.S.Army Engineer District Kansas City Geotechnical Branch

Laser induced
fluorescence
of POL via
fiber optics

5EAK01



26.50 Eaker AFB Probe Depth; Project;

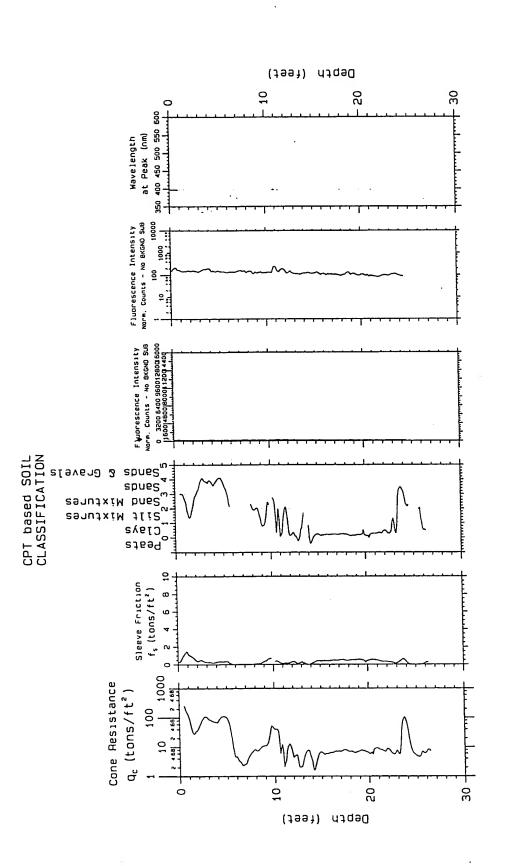
PT; 6EAK01

Site Characterization and Analysis Penetrometer Syste

U.S.Army Engineer District Kansas City

Laser induced
fluorescence
of POL via
fiber optics

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26.55 Eaker AFB Project;

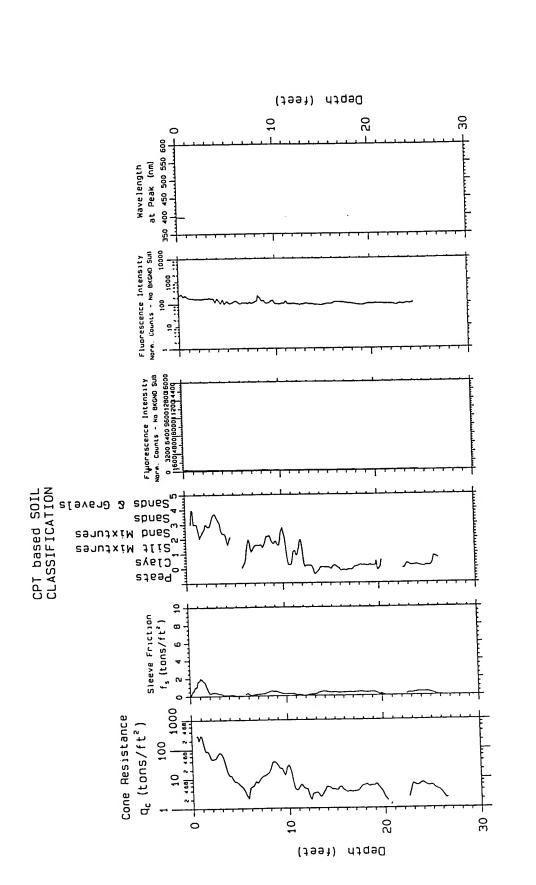
Probe Depth;

Probing date; 03-24-1995

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Laser induced fluorescence of POL via fiber optics

Site Characterization and Analysis Penetrometer System



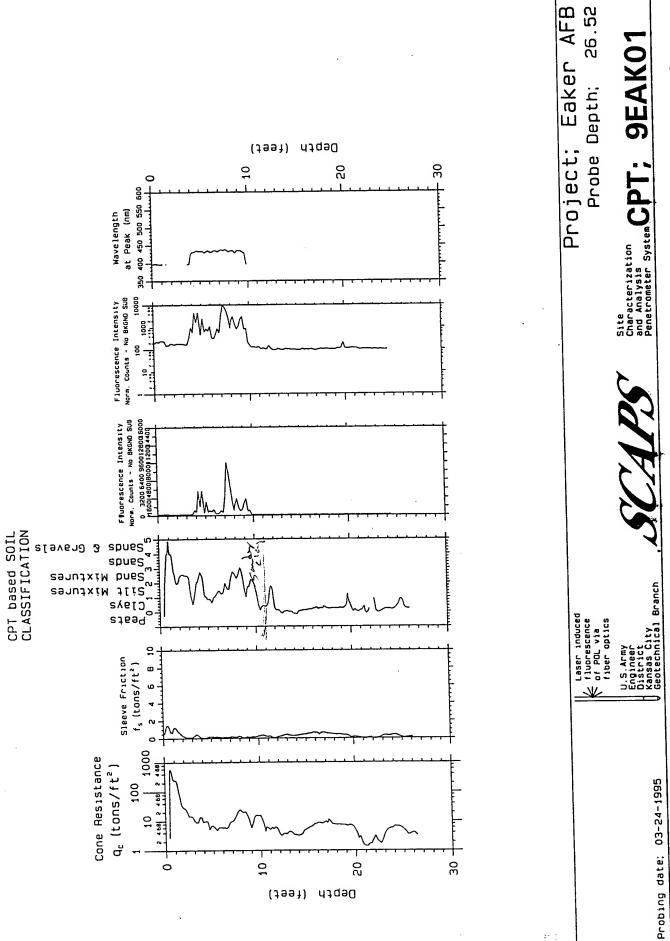
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CPT; 8EAK01

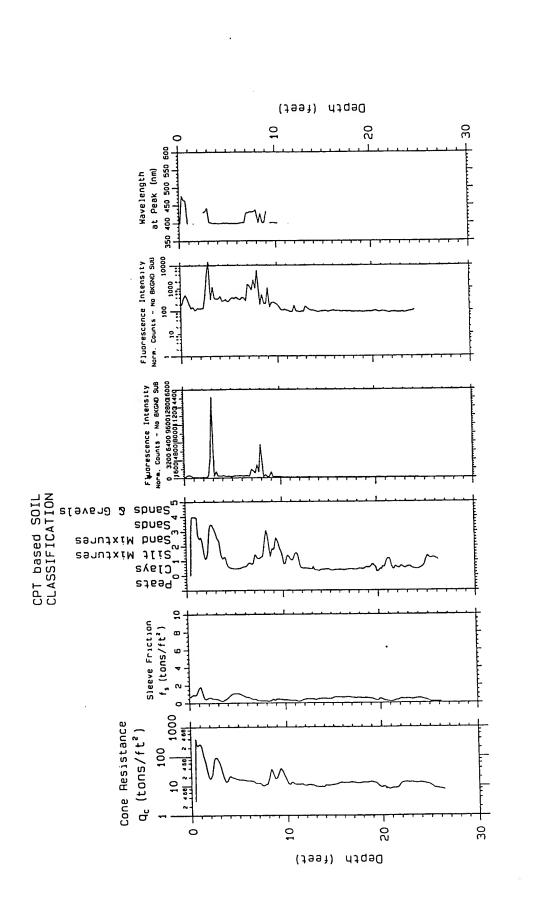
Site Characterization and Analysis Penetrometer System

Laser induced
fluorescence
of POL via
fluor optics U.S.Army Engineer District Kansas City

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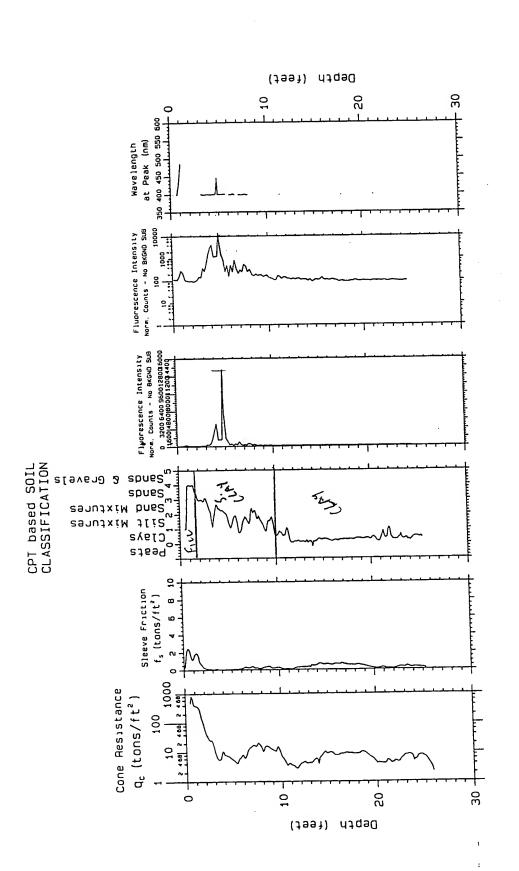
26.55 Eaker AFB Probe Depth; Project;

CPT; 10EAK01

Site Characterization and Analysis Penetrometer System

U.S.Army Engineer District Kansas City Geotechnical

Laser induced fluorescence of POL via



26.62 Eaker AFB Probe Depth; Project;

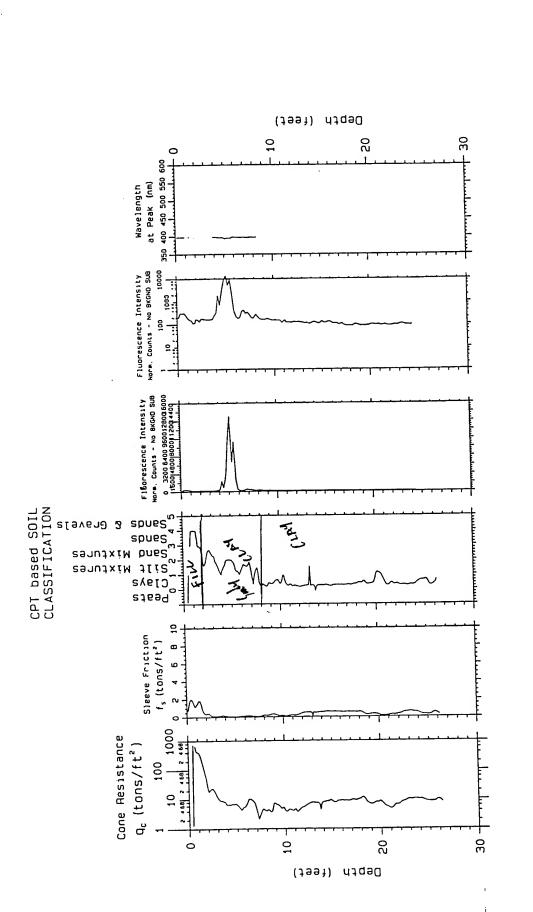
11EAK01 Site Characterization and Analysis Penetrometer System

Probing date; 03-25-1995

U.S.Army Engineer District Ransas City Geotechnical Branch

Laser induced fluorescence of POL via fiber optics

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Eaker AFB 26.49 Probe Depth; Project;

CPT; 12EAK01 Site Characterization and Analysis Penetrometer System

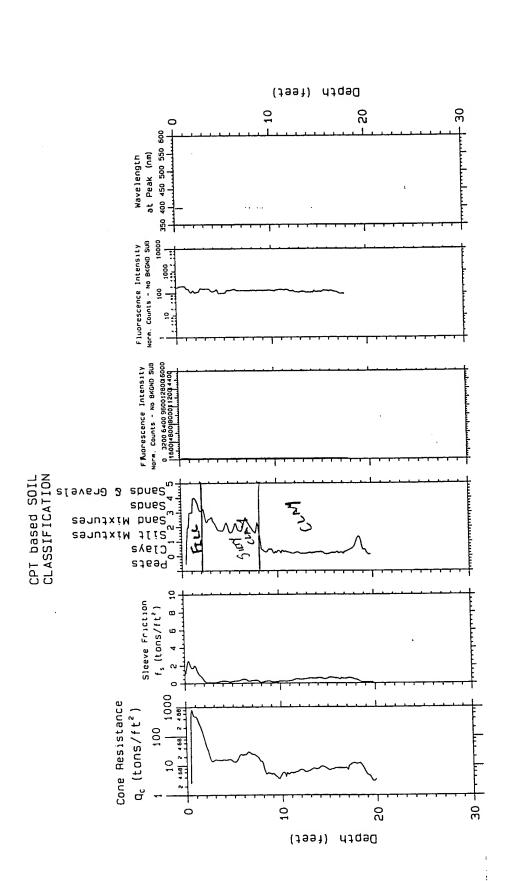
Laser induced
fluorescence
of POL via

U.S.Army Engineer District Kansas City,

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20.05 Eaker AFB Probe Depth; Project;

Site Characterization and Analysis Penetrometer System

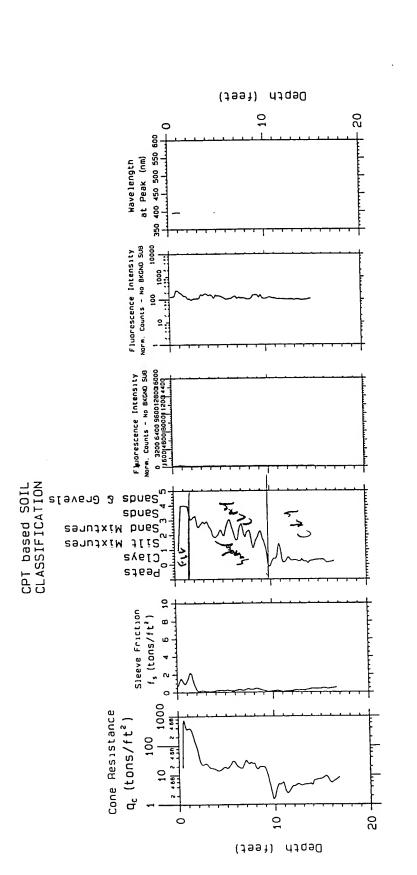
Probing date; 03-25-1995

Laser induced fluorescence of POL via fiber optics

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13EAK01



Project; Eaker AFB Probe Depth; 17.04

Site Characterization and Analysis Promete

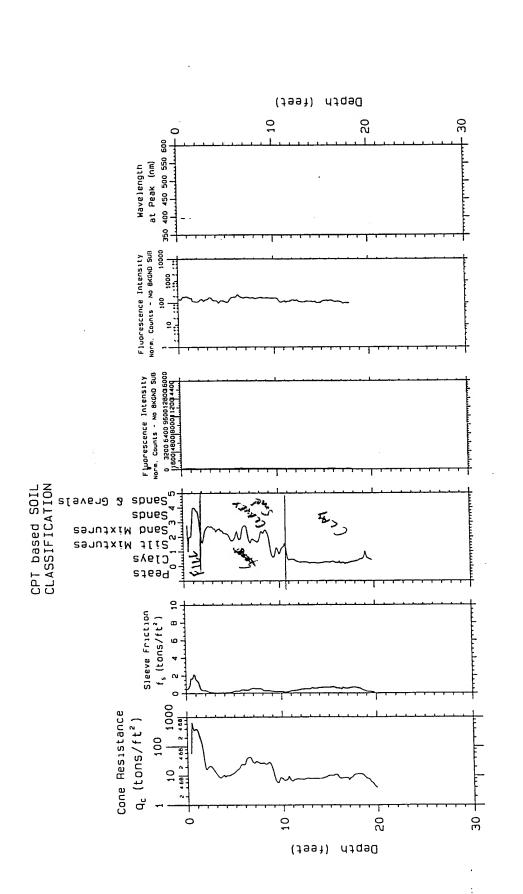
CPT: 14EAK01

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Laser induced
fluorescence
of POL via
fiber optics
U.S. Army
Engineer
District

3-25-1995

Probing date; 03-25-1995



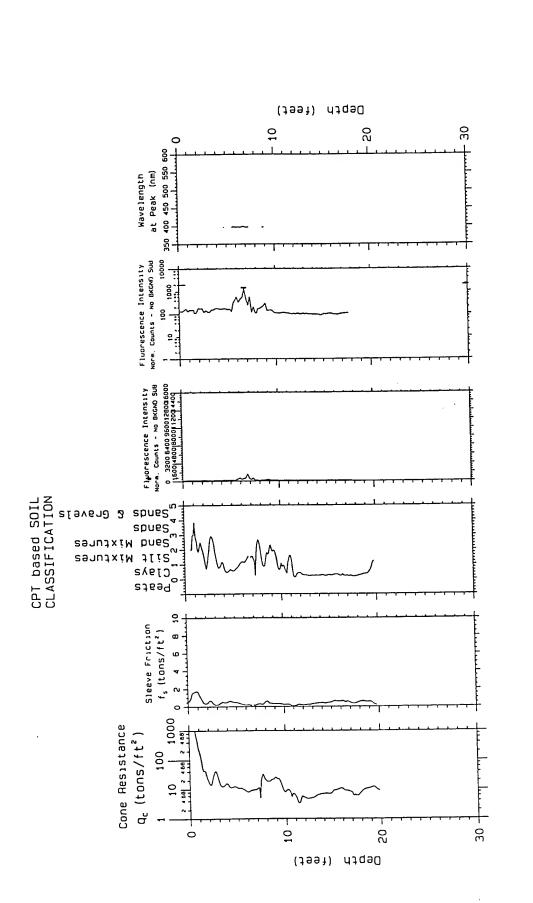
20.12 AFB Eaker Probe Depth; Project;

15EAK01 Site Characterization and Analysis Penetrometer System CPT;

U.S.Army Engineer District Kansas City Geotechnical Branch

Laser induced
fluorescence
of POL via
fiber optics

Probing date; 03-25-1995



20.05 Eaker AFB Probe Depth; Project;

CPT; 16EAK01

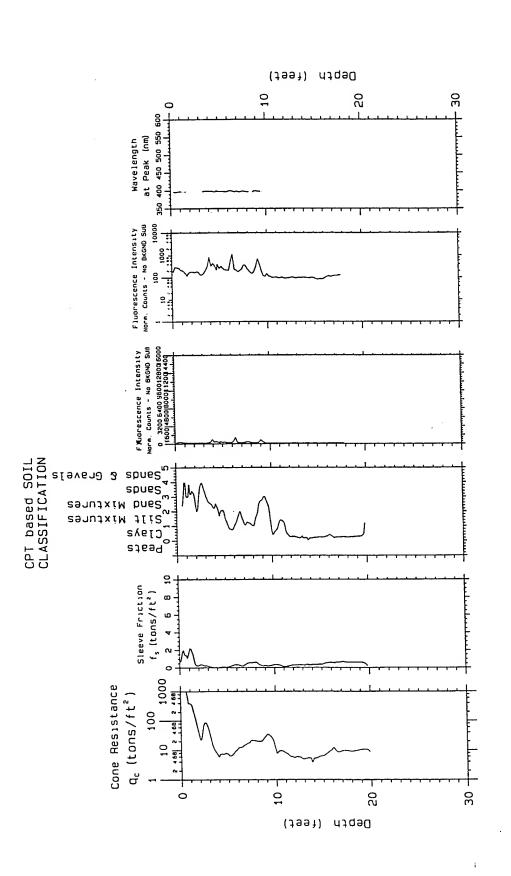
Site Characterization and Analysis Penetrometer System

Laser induced
fluorescence
of POL via
fiber optics U.S.Army Engineer District Kansas Ci

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Eaker AFB Probe Depth; 20.03 Project;

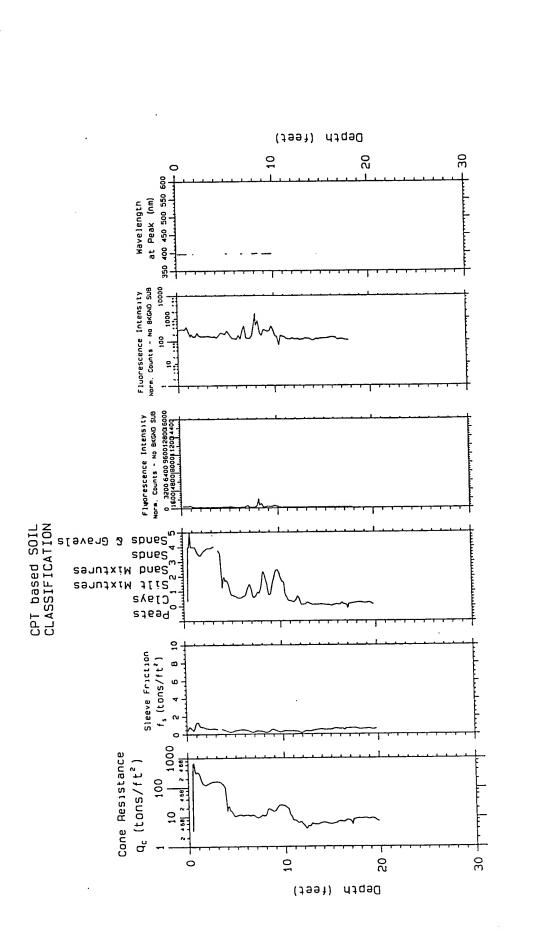
Probing date; 03-25-1995

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fluorescence
of POL via
fiber optics

Site Characterization and Analysis Penetrometer System CPT,

17EAK01



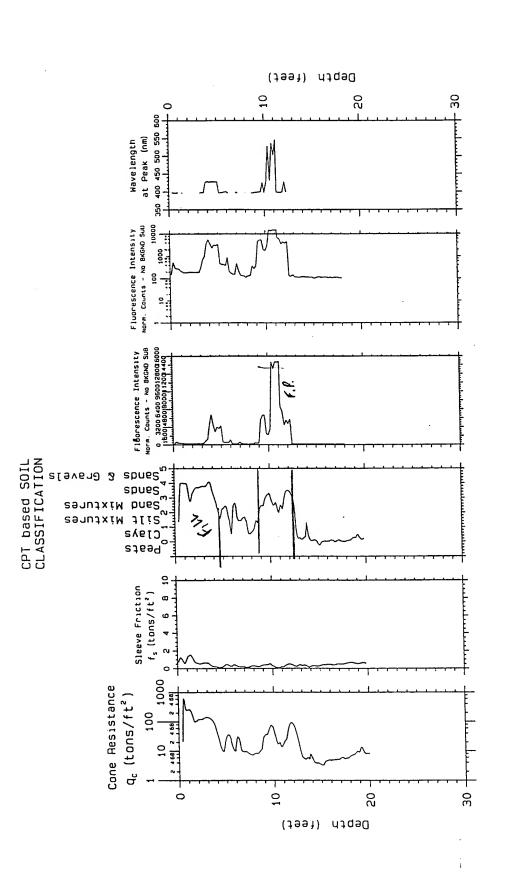
20.09 Eaker AFB Probe Depth; Project;

Site Characterization and Analysis Penetrometer System

18EAK01

Laser induced
fluorescence
of POL via
fiber optics

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20.12 Eaker AFB Probe Depth; Project;

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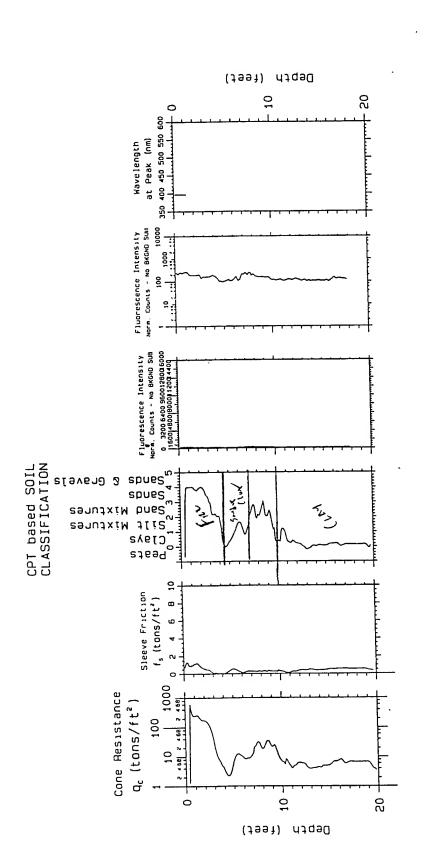
Site Characterization and Analysis Penetrometer System

19EAK01

Probling date; 03-25-1995

Laser induced fluorescence of POL via fiber optics

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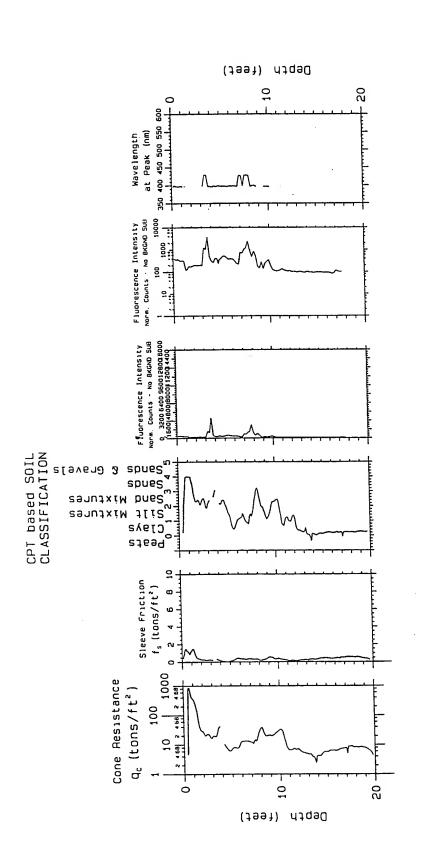
19.97 Eaker AFB Probe Depth; Project;

U.S.Army Engineer District Rasas City Geotechnical Branch

Probing date; 03-25-1995

Laser induced
fluorescence
of POL via
fiber optics

Characterization CPT; 20EAK01



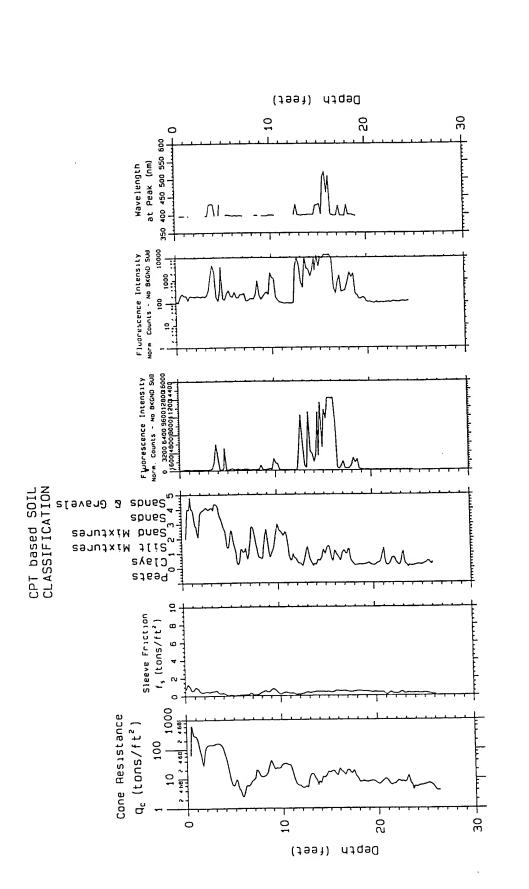
19.93 Eaker AFB Probe Depth; Project;

Laser induced
fluorescence
of POL via
fluor optics

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Site Characterization and Analysis Penetrometer System

Probing date; 03-25-1995



26.46 Eaker AFB Probe Depth; Project;

Site Characterization and Analysis Penetrometer Syste

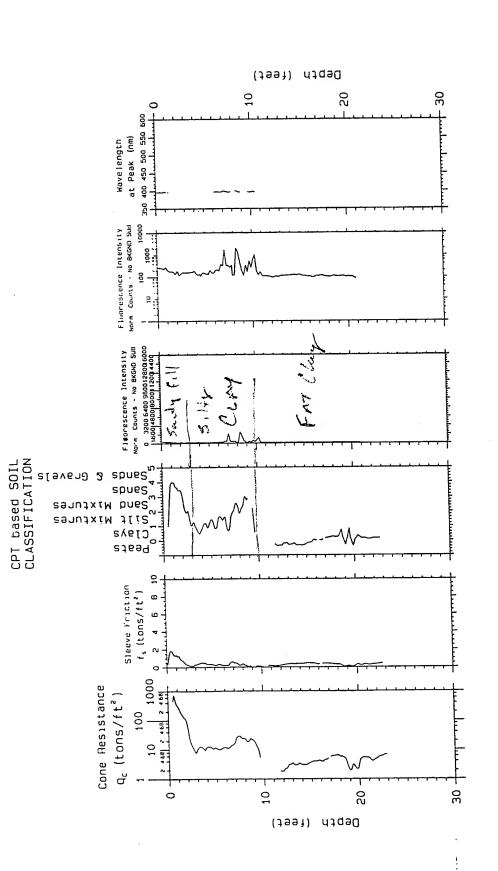
22EAK01

Laser induced fluorescence of POL via fiber optics

U.S. Army Engineer District Kansas Ci

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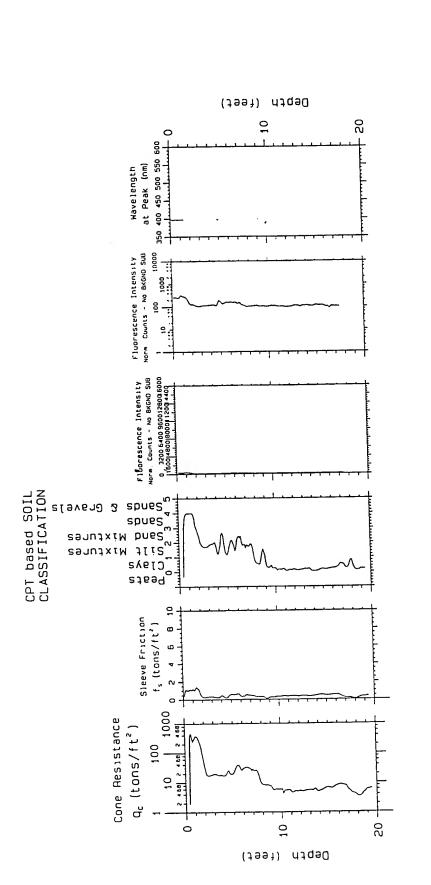
23.07 Eaker AFB Probe Depth; Project;

Laser induced
fluorescence
of POL via
fiber optics

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Site Characterization CPT; 23EAK01 penetrometer System CPT;



19.69 Eaker AFB Probe Depth; Project;

Site Characterization and Analysis Penetromet<u>er Sy</u>ste

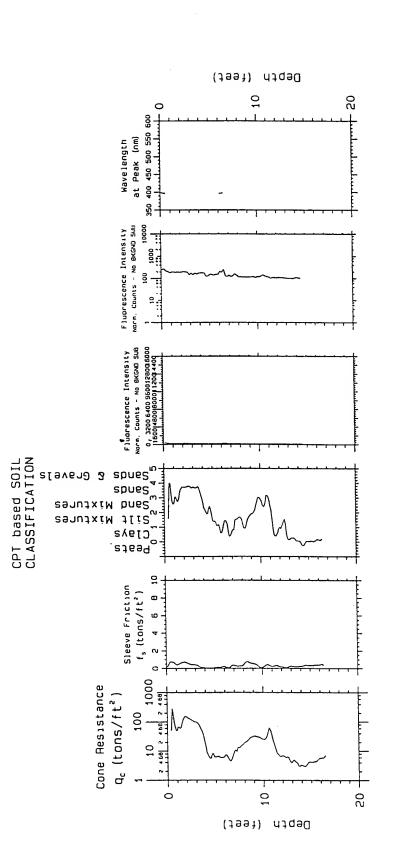
;PT; 24EAK01

Laser induced
fluorescence
of POL via
fiber optics

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U.S.Army Engineer District

Probling date, 33-25



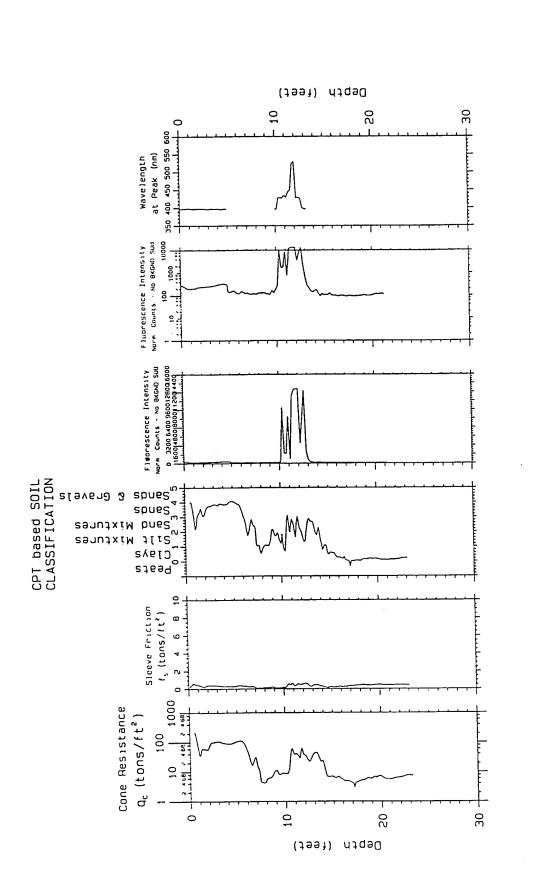
16.65 Eaker AFB Probe Depth; Project;

Probing date; 03-25-1995

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Laser induced fluorescence of POL via fiber optics

Characterization CPT; 25EAK01



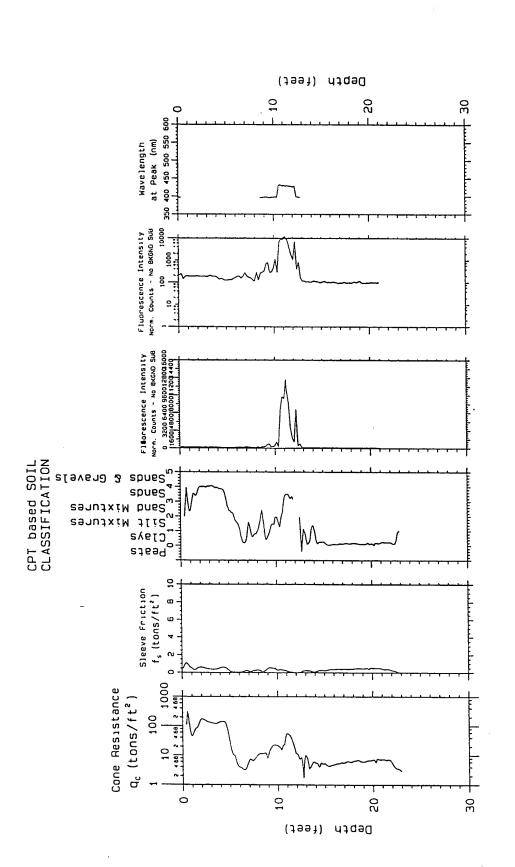
Eaker AFB Probe Depth; 23.40 Project;

Site Characterization CPT; 26EAK01 Penetrometer System CPT; 26EAK01

Probing date: 03-25-1995

Laser induced
fluorescence
of POL via
fiber optics

U.S.Army Engineer District Kansas City Geotechnical



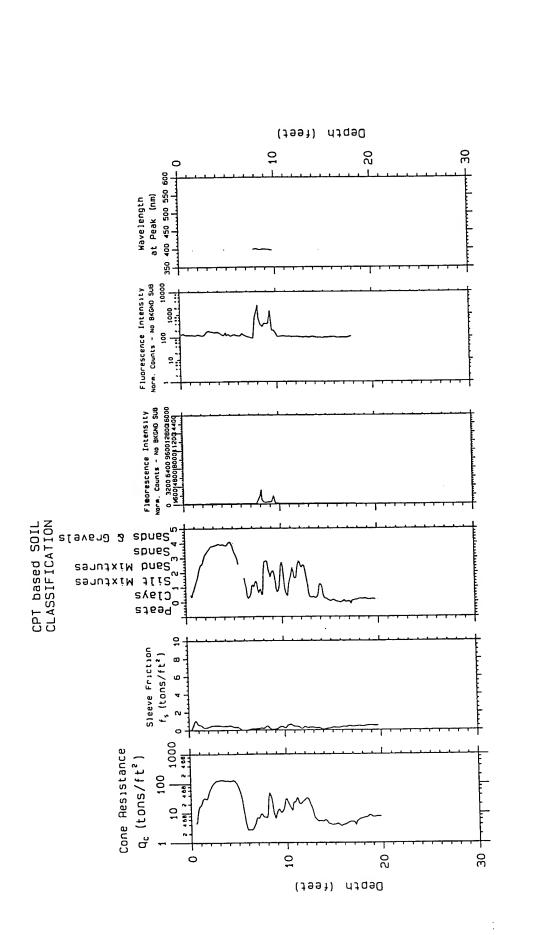
Eaker AFB 23.18 Probe Depth; Project;

Characterization CPT; 27EAK01

Probing date; 03-25-1995

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Laser induced fluorescence of POL via fiber optics



20.05 Eaker AFB Probe Depth; Project;

CPT; 28EAK01

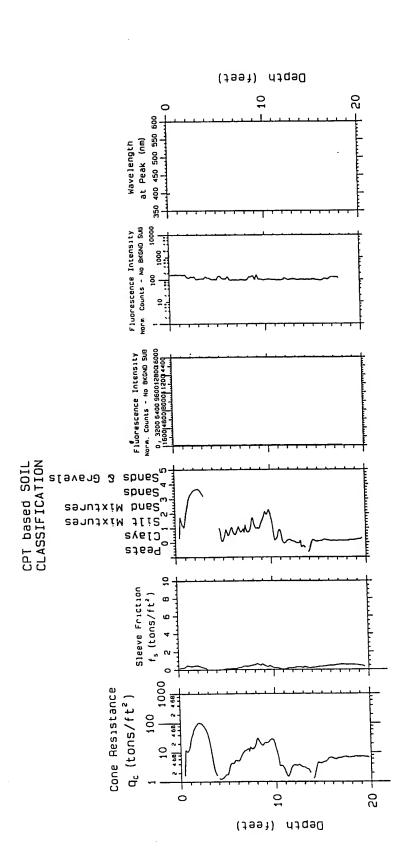
Site Characterization and Analysis Penetrometer System

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Laser induced fluorescence of POL via

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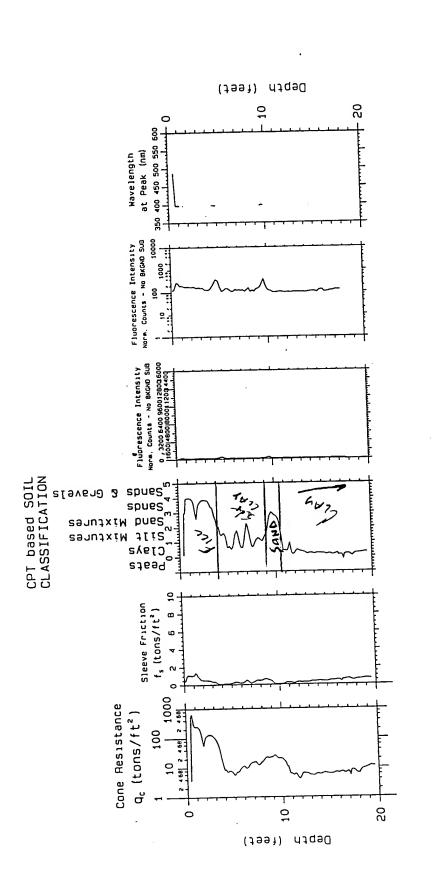
Eaker AFB 19.91 Probe Depth; Project;

Probing date; 03-25-1995

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Laser induced fluorescence of POL via floer optics

29EAK01 Site Characterization and Analysis Penetrometer System CPT;



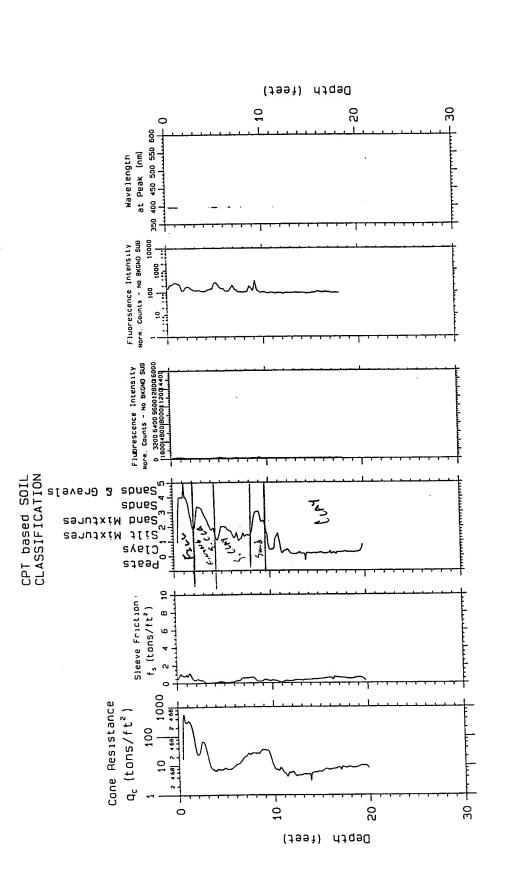
19.76 Eaker AFB Probe Depth; Project;

CPT; 30EAK01 Site Characterization and Analysis Penetrometer System

U.S.Army Engineer District

Laser induced
fluorescence
of POL via
fluor optics

Probling date, 03-25-,55



20.12 Eaker AFB Probe Depth; Project;

Laser induced fluorescence of POL via fiber optics

U.S.Army Engineer Diskring Kansas City Geotechnical Branch

Site Characterization CPT; 31EAK01 penetrometer System CPT;

Probing date; 03-25-1995